Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

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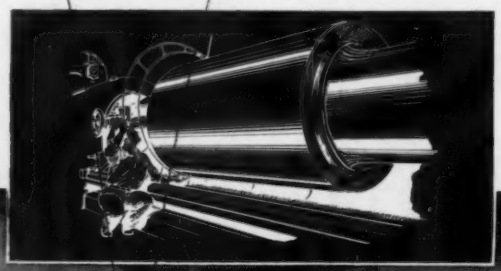
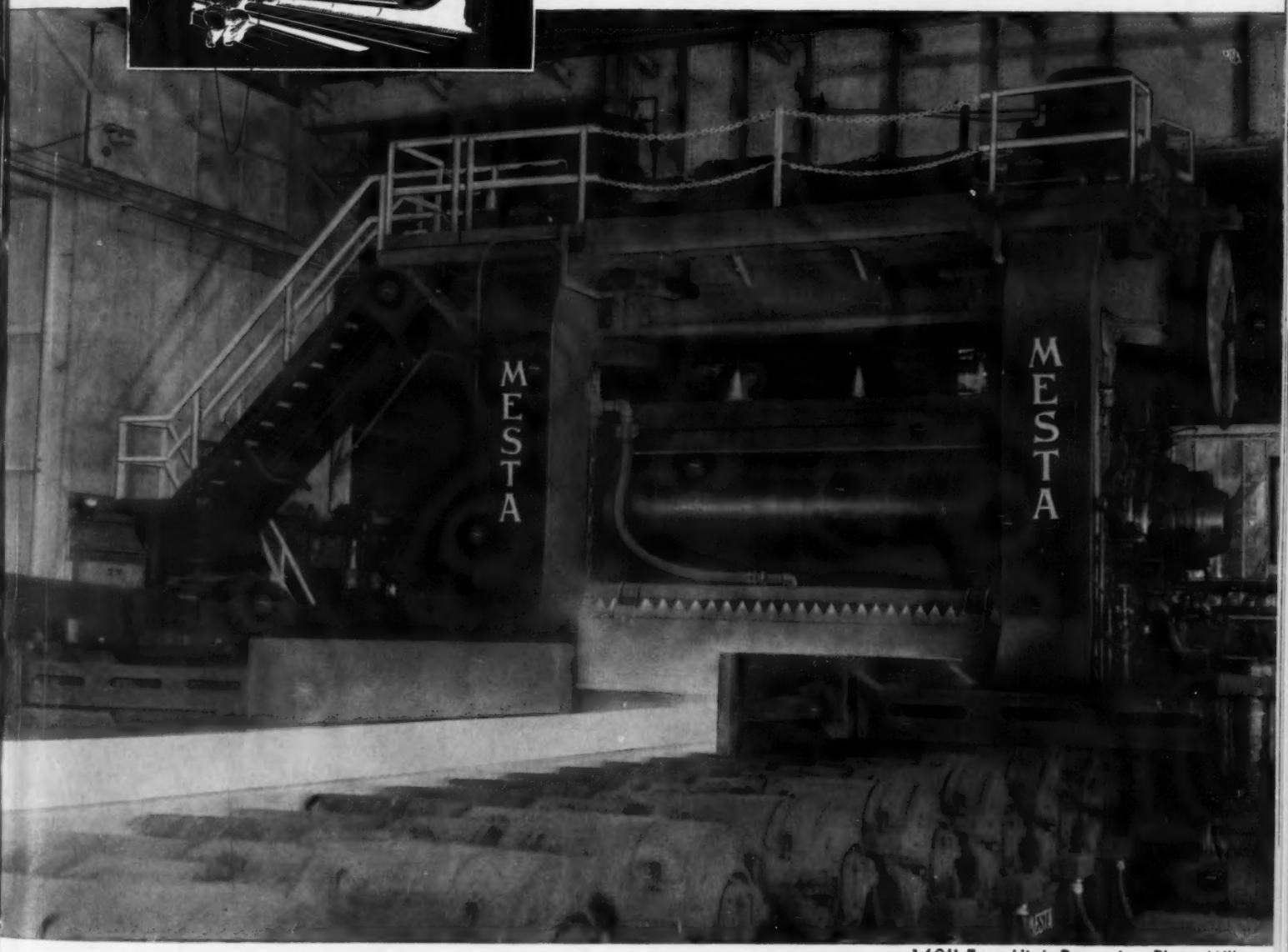
TECHNOLOGY DEPARTMENT

PLATE MILLS *designed and built by*

MESTA



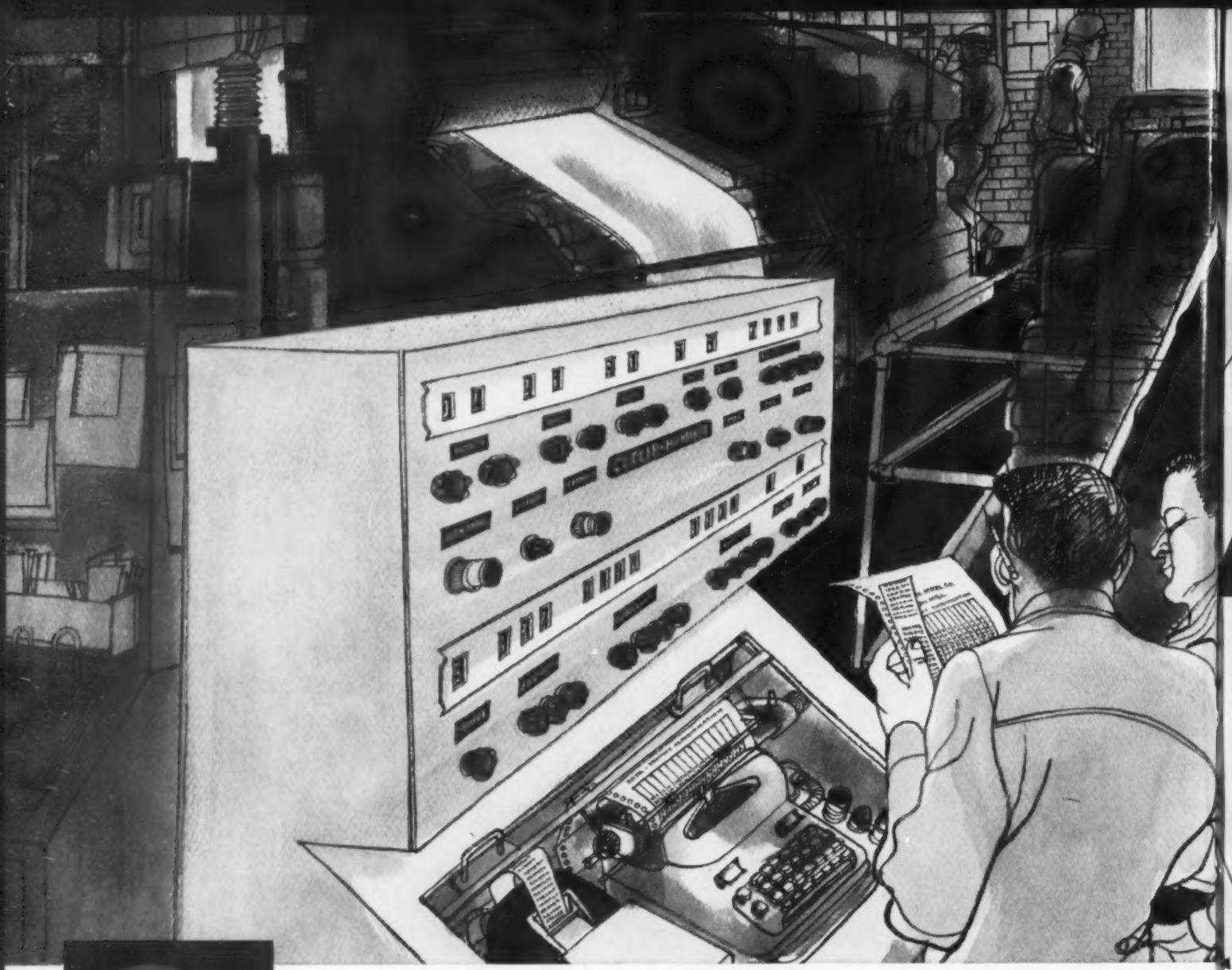


160" Four-High Reversing Plate Mill

MESTA *Machine Company*

Pittsburgh, Penna.

MESTA
DESIGNERS AND BUILDERS OF COMPLETE STEEL PLANTS



CONTROL

New machine with a memory licks a quality problem 3 miles long!

It's relatively simple to control quality of tinplate sheets by running them individually through sensing stations. But, how do you check and control quality in a *coil* of tinplate up to 16,000 feet long?

Working with a leading tinplate producer, Cutler-Hammer engineers devised an ingenious new type of computer that hooks right onto the sensing stations and automatically keeps track of every defect. When the tape is checked, production controls can be quickly adjusted to compensate for any deviation from standard.

This is an example of the new thinking, the new vitality at Cutler-Hammer. We're on the move . . . with new products, new ideas, new engineering talent. We've solved problems that other companies in our field wouldn't even tackle. One of our divisions, with extensive microwave and electronic experience, gives us even more creative muscle in all fields of industrial automation.

Even our trademark's new, to symbolize the new Cutler-Hammer. Phone one of our sales offices and see how we can fit on your team.

WHAT'S NEW? ASK...

CUTLER-HAMMER

CONTROL

Cutler-Hammer Inc., Milwaukee, Wis. • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C.A.
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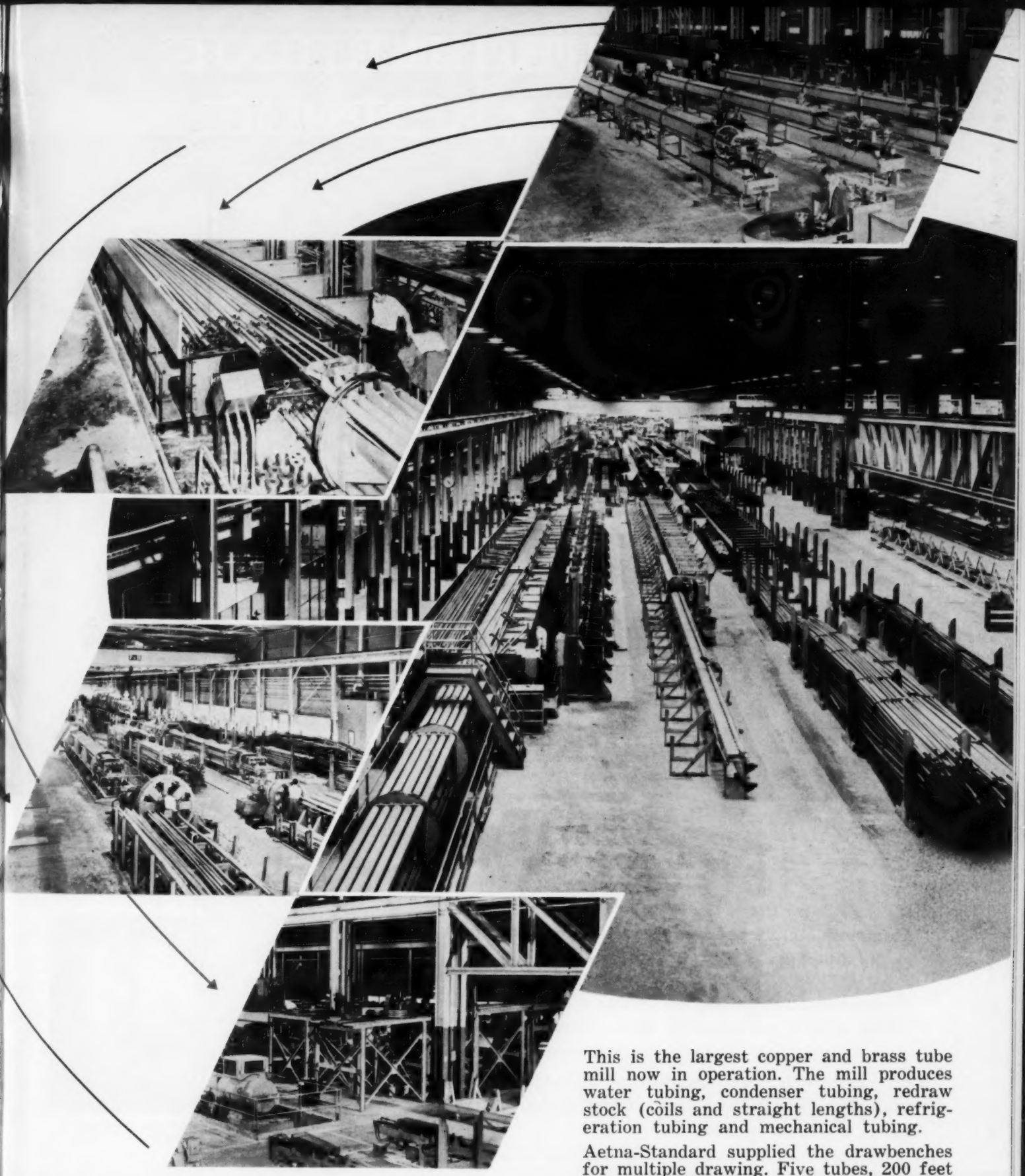

BRASS and COPPER TUBE MILL...

This is the largest copper and brass tube mill now in operation. The mill produces water tubing, condenser tubing, redraw stock (coils and straight lengths), refrigeration tubing and mechanical tubing.

Aetna-Standard supplied the drawbenches for multiple drawing. Five tubes, 200 feet in length, are drawn in a single pass. Aetna-Standard also supplied high speed 60-inch Bull Blocks with turn-style coil handling.

For information on Cold Draw equipment, write to: Aetna-Standard Division
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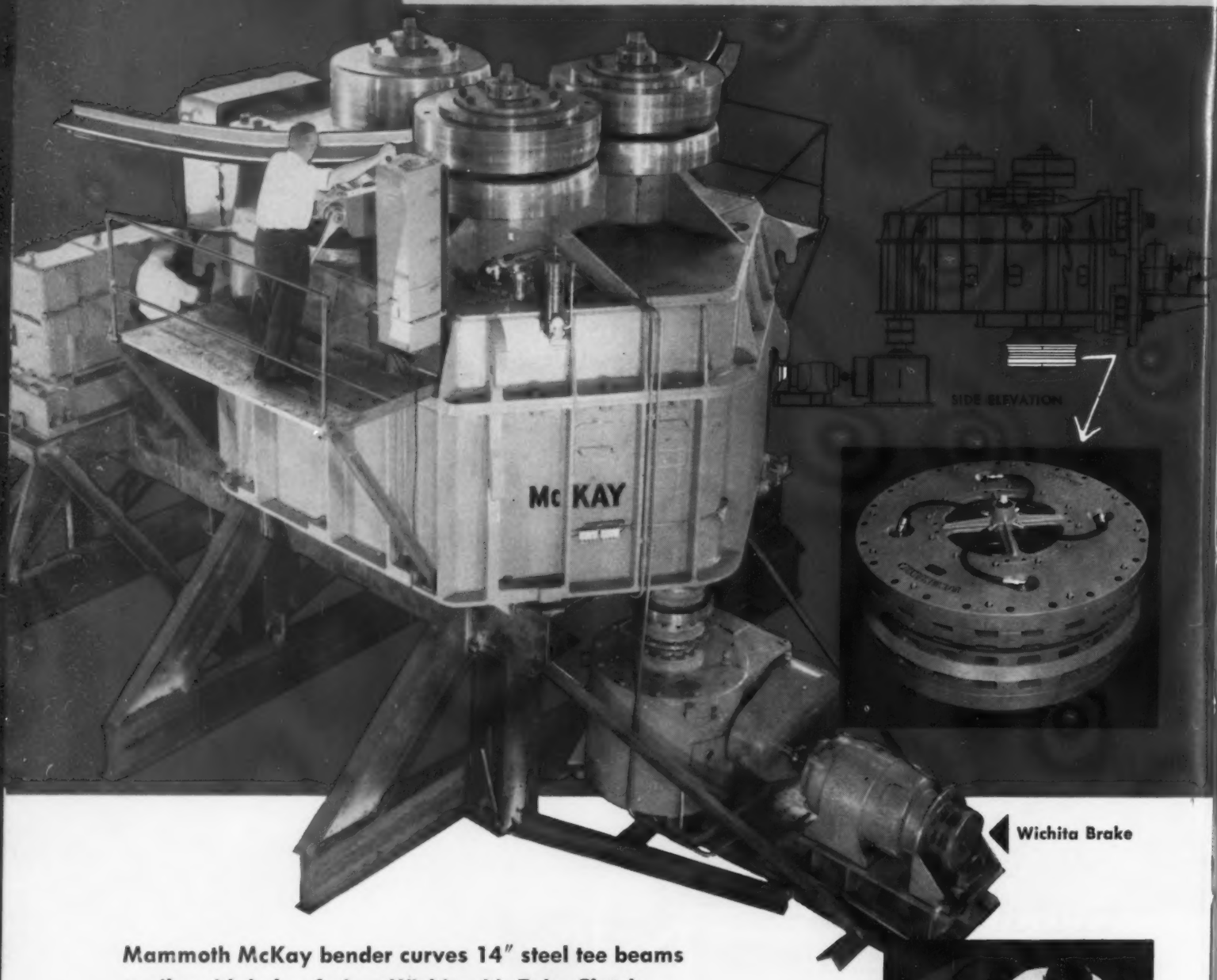
Pittsburgh, Pennsylvania

Aetna-Standard Division

BLAW-KNOX

WORLD'S LARGEST STRUCTURAL BENDER USES

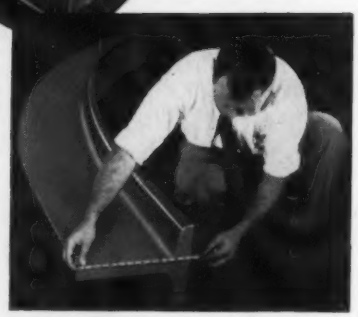
LARGEST AIR TUBE CLUTCH



Wichita Brake

Mammoth McKay bender curves 14″ steel tee beams easily with help of giant Wichita Air Tube Clutch

Tremendous torque is applied through a 48″ Wichita Air Tube Disc Clutch at 0.75 rpm from the 60 hp, 1650 rpm drive motor to the center driving roll. McKay engineers report Wichita ATD clutch provides smooth power application in spite of heavy loads. For your unusual or difficult clutching or braking problems it will pay you to call in a Wichita engineer.



Structural tee shape bent stem out — 10″ flange, 14″ stem.

Contact your nearest Wichita Engineer.

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Iron AND Steel ENGINEER

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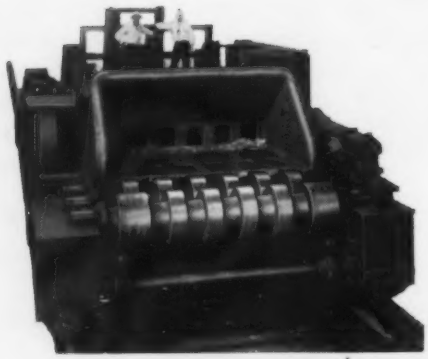

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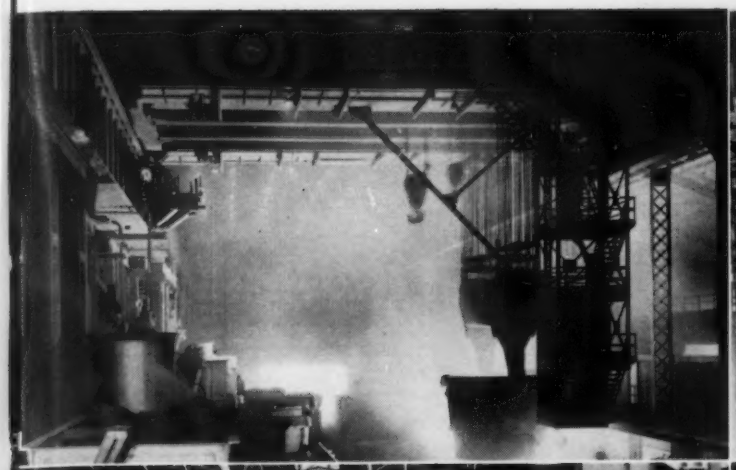
Overhead Cranes * Gantry Cranes * Mill Cranes and Equipment * Hot Metal Cranes Ladle Cranes * Stripper Cranes * Soaking Pit Cranes * Soaking Pit Cover Cranes Charging Machines * Furnace Chargers * Slab Handling Cranes * Bucket Cranes Magnet Cranes * Mold Yard Cranes * Skull Cracker Cranes * Ingot Buggies * Run-Out Tables * Car Dumpers * Special Mill Equipment * Ore & Coal Bridges * Loading & Unloading Towers * Forging Manipulators * Forging Cranes * Power House & Dam Cranes * Dock & Pier Handling Equipment * Research, Development & Engineering Service * Licensees & Manufacturing Facilities in Other Countries.



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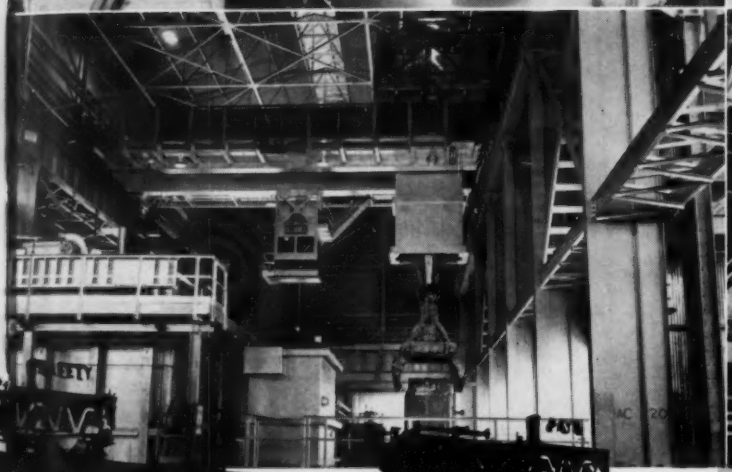

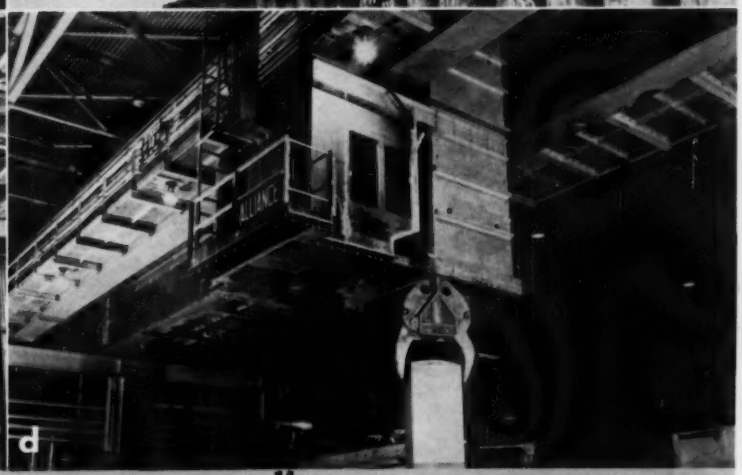

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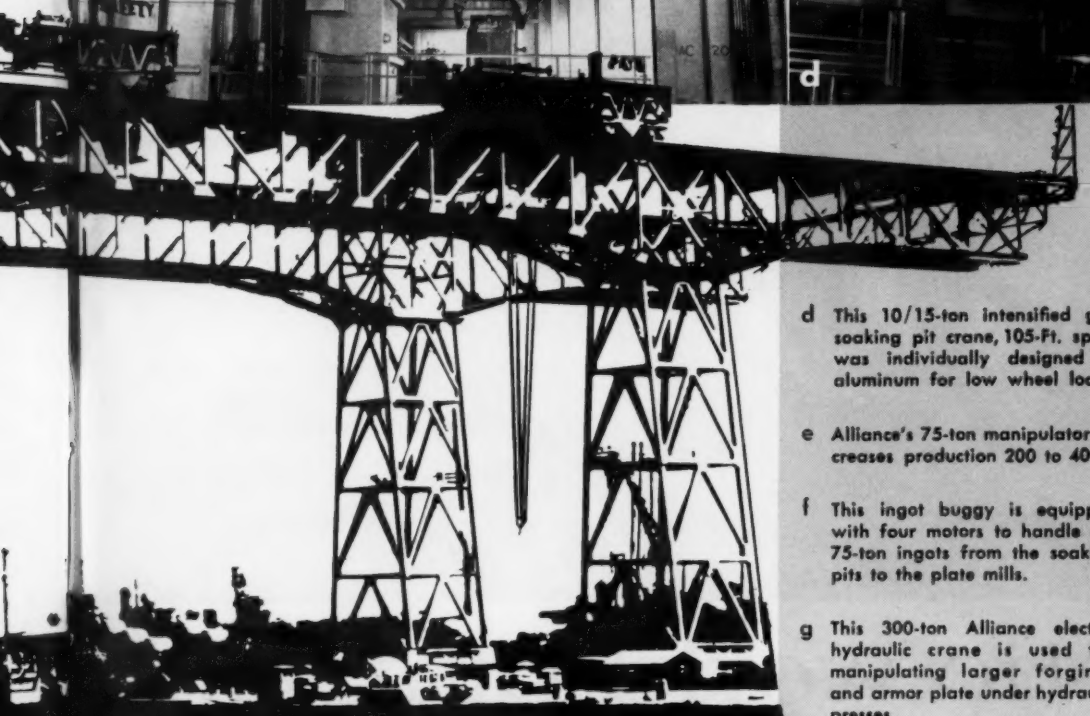


a This 525/100/20-ton 4-girder ladle crane, 69' 6" span, operates without vibration under all operating conditions.

b This 400-ton push-pull stripper crane exerts 2½ million pounds of pressure to strip molds cleanly from ingots.

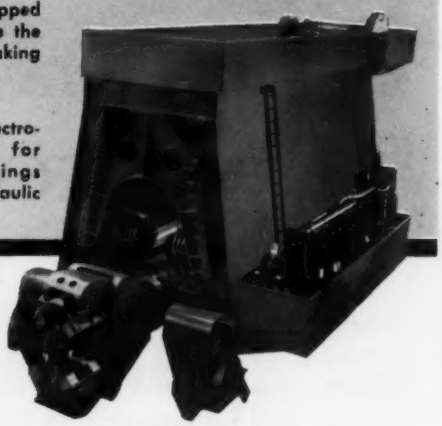
c This 75-ton intensified grip soaking pit crane with a span of 66 ft. handles ingots from 5-75 tons with two set of interchangeable tongs.

d This 10/15-ton intensified grip soaking pit crane, 105-Ft. span, was individually designed of aluminum for low wheel loads.

e Alliance's 75-ton manipulator increases production 200 to 400%.

f This ingot buggy is equipped with four motors to handle the 75-ton ingots from the soaking pits to the plate mills.

g This 300-ton Alliance electro-hydraulic crane is used for manipulating larger forgings and armor plate under hydraulic presses.



e

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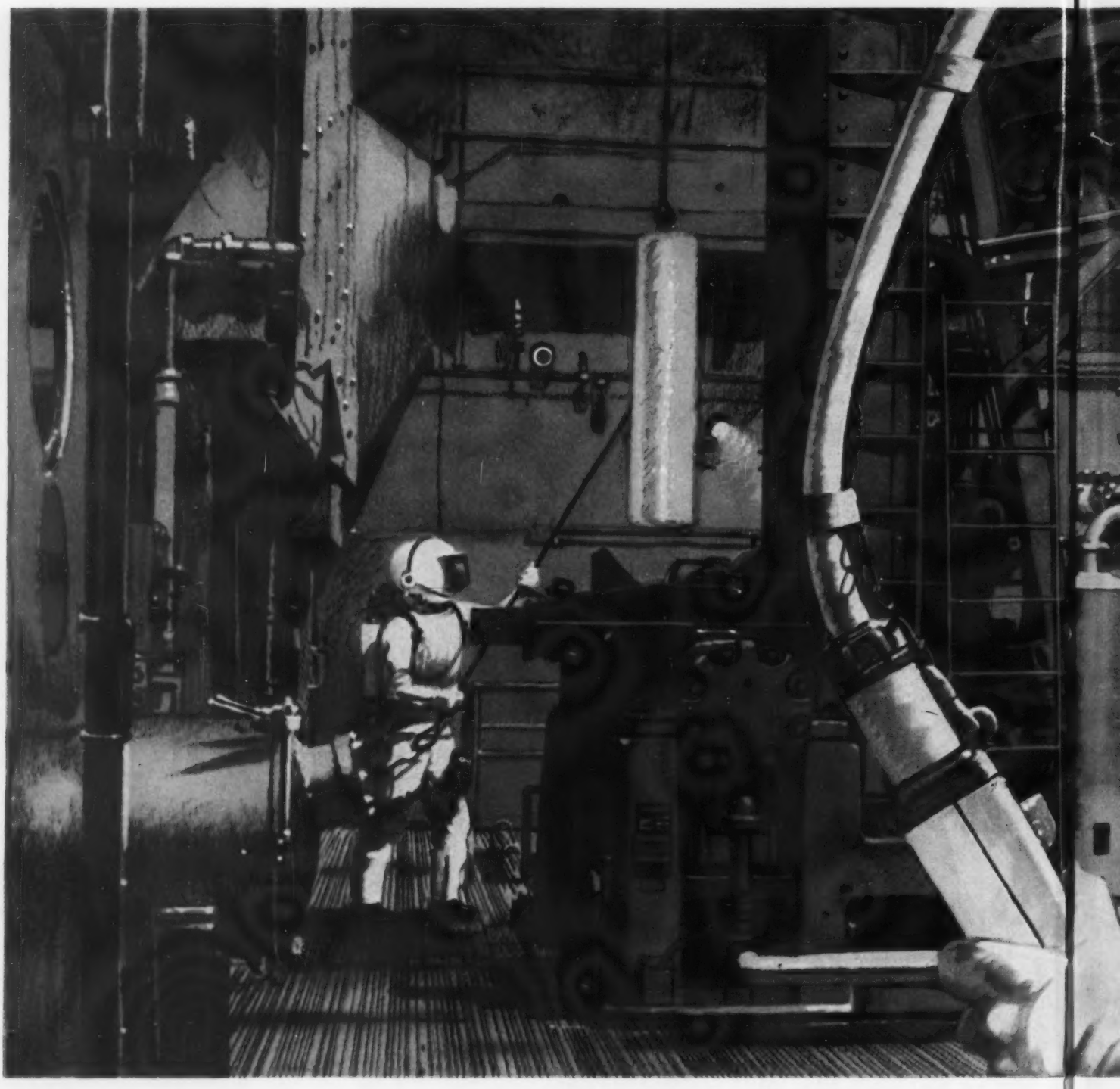

The exotic world of space

Imagine a plant without air . . . where workers must operate in space suits . . . surrounded by an atmosphere of pure argon gas. These are the conditions at Universal-Cyclops Steel Corporation's In Fab project at Bridgeville, Pennsylvania.

This unique plant was developed because exotic space age metals such as tantalum, molybdenum, columbium, should be forged and hot processed in an oxygen-free atmosphere . . . *a world of their own*. Otherwise they may react violently or break down. Yet, because these refractory metals can retain strength far above temperatures that would destroy most materials, they are vitally needed for nose cones, re-entry vehicles, jet and rocket engines.

As a result, Universal-Cyclops—in conjunction with the Department of the Navy—built a hermetically sealed plant where rolling mill, impactor, induction furnace and

e age metals... *where Mobil is right at home!*

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Speed, flexibility, uniformity of anneal and compactness make the Open Coil System the most advanced method of annealing available today. If you are not already familiar with the Open Coil System why not dial Lee Wilson and have a sales engineer contact you at your convenience.

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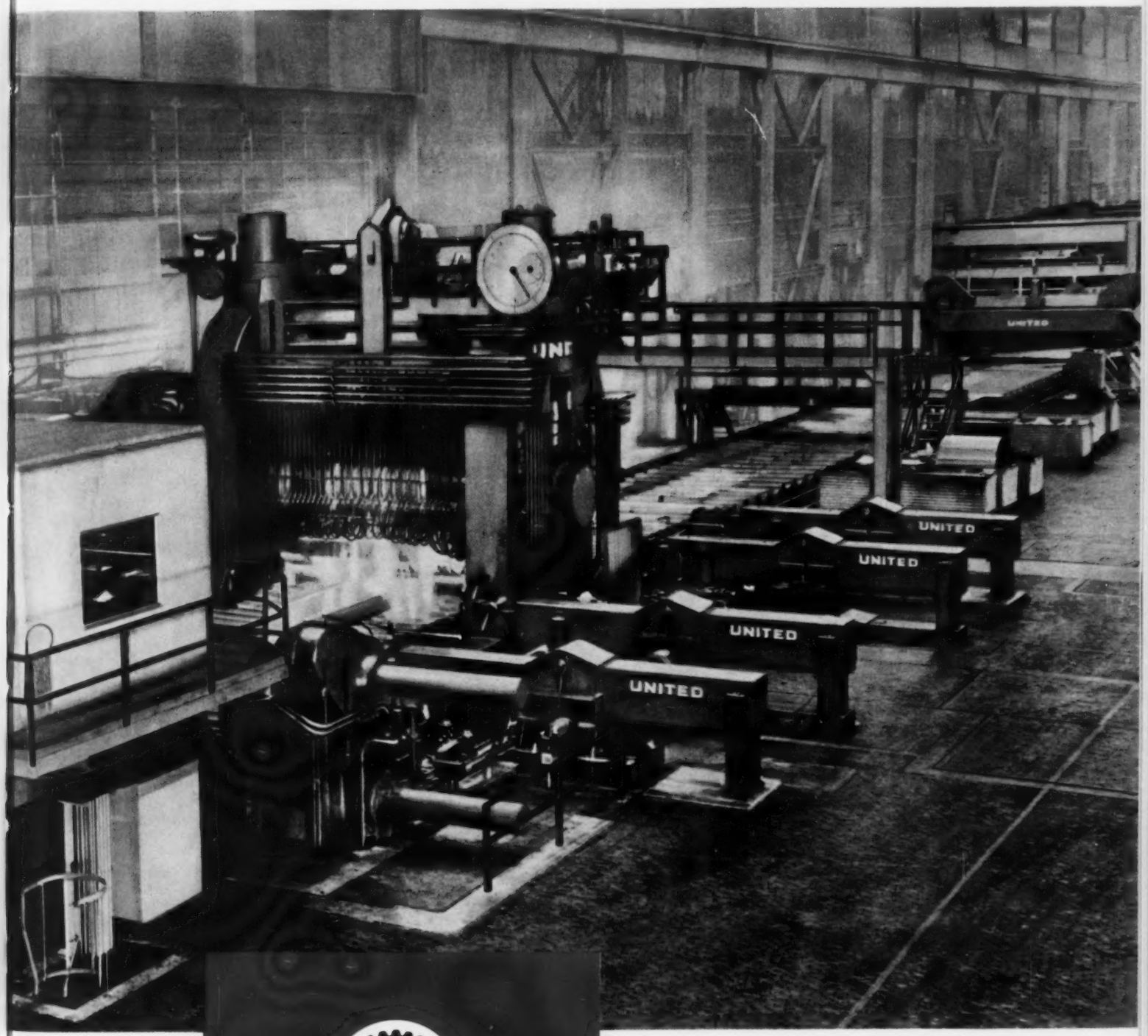

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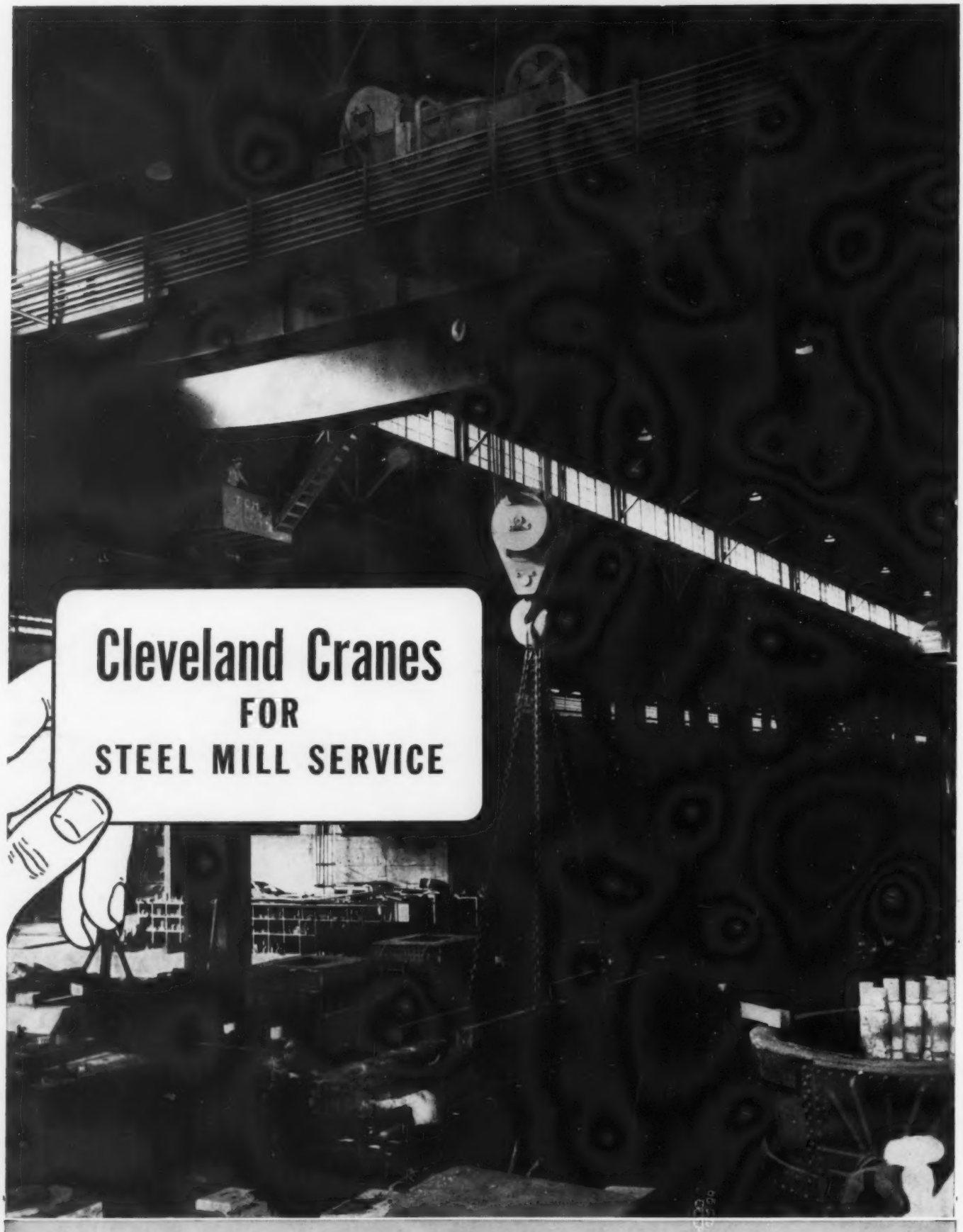

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Crops *and* Shorts

△ In a speech before the Engineering Society of Detroit, Austin J. Paddock, president of United States Steel Corp.'s American Bridge Division, challenged design engineers to utilize what he termed "penicillin steels"—steels that have been developed through the years but figuratively linger on the shelf awaiting the proper application.

"It is too bad," he said, "that in the popular mind—and all to frequently in the mind of many engineers—steel is just plain old garden variety low carbon steel. Steel has never been glamorized like the wonder drugs. Actually steel is as modern as today with almost unlimited end uses."

He gave as an illustration the rocket expert who sought a wonder metal for use in the free flight section of a missile. He found it when he "discovered" a 25-year-old high strength steel.

"To find the right prescription is the design engineer's high trust," said Mr. Paddock.

△ The American Iron and Steel Institute at its 68th general meeting last month awarded the Institute Medal to two men for outstanding papers presented at the 1959 meeting. The winners were E. J. Hanley, president of Allegheny Ludlum Steel Corp., for his address "The Minutes of The Last Meeting," and J. S. McMahan, superintendent of blast furnaces, The Steel Co. of Canada, Ltd., for his paper "Experience With Self-Fluxing Sinter."

Both papers, incidentally, were subsequently published in Iron and Steel Engineer.

△ We have heard an unconfirmed rumor that help is on the way in the form of a simplified income tax return that contains only four lines:

1. What was your income last year?
2. What were your expenses?
3. How much have you left?
4. Send it in.

△ Steel output has increased its proportionate share of industrial production according to the Federal Reserve Board's revised index. Covering the period 1953 to date, steel production is placed at 6.21 per cent as against the former figure of 5.37 per cent.

The revision portrays more growth over the post-war period than the former index.

△ Ever wonder what the garage mechanics wipe their hands on when they run out of steering wheels?

△ David J. McDonald, president of the United Steel Workers, stated that it is time to "face up" to a 4-day work week to combat creeping unemployment. Said Mr. McDonald "there must be an alternative beyond what we have already won in the form of SUB and improved retirement plans, more liability insurance coverage and hospitalization during layoffs."

According to Davy's economic logic we can best assure business stability by extending more and more benefits to more and more people for doing less and less work.

Oh, that we too might dwell in fantasyland and live happily ever after!

△ Refuting the oft-heard charge that Washington bureaucrats lack common sense is this quote from a federal agency air raid manual: "All funeral coaches must pull to the curb when the siren sounds, although the occupants are not required to seek shelter."

△ From a survey conducted by the Engineering Manpower Commission of Engineers Joint Council, the following causes were listed for the continued decline in freshman engineering enrollment:

1. Increased interest by qualified students in other fields of science.
2. Concern over the rigors and demands of engineering education.
3. Decrease in applications from students lacking in genuine interest and motivation for engineering.

According to the survey, based on statements from 150 engineering deans, the downtrend started in 1958–59 when freshmen engineering enrollment dropped 11.1 per cent over the previous year. The 1959–60 drop was 3.4 per cent.

Many deans were critical of the high school preparation received by engineering applicants. There was also a general consensus on the need for the engineering profession to establish more effective means of communicating to young people facts about engineering, its importance and its rewards.

△ A local paper in New Zealand has taken the ultimate stand in editorial protection. It closes each issue with the words "Opinions expressed in this periodical are not necessarily condoned or even understood by the editorial staff."

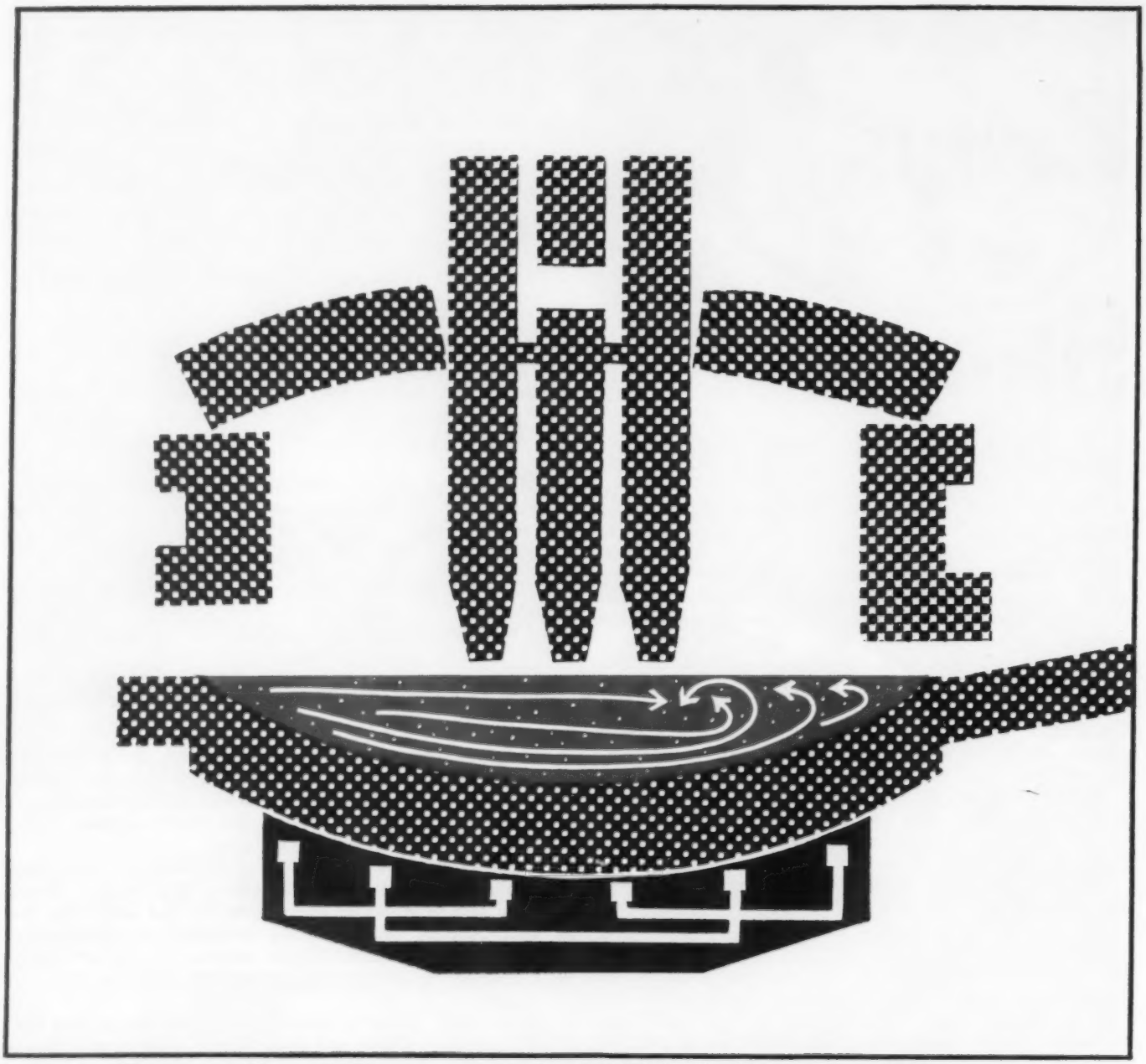
△ And, then there is this definition of an executive: a man who goes from his air-conditioned office, in an air-conditioned car, to his air-conditioned club—to take a steam bath.

△ According to figures released by the American Iron and Steel Institute, the aggregate payroll for hourly and salaried employees in the iron and steel industry was a record $1,540,115,050 during the first four months of 1960. The total for the comparable period last year was $1,441,458,155.

The industry's employment of hourly and salaried workers was 636,569 in the initial four months of 1960, as against 590,651 during the same part of 1959.

The payroll cost per hour worked by hourly employees during the 1960 interval was $3.376, against $3.332 during the first four months of last year.

△ A disillusioned friend says that golf is a long walk punctuated with disappointments.



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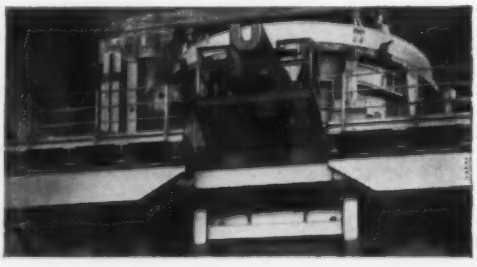


in 1960...

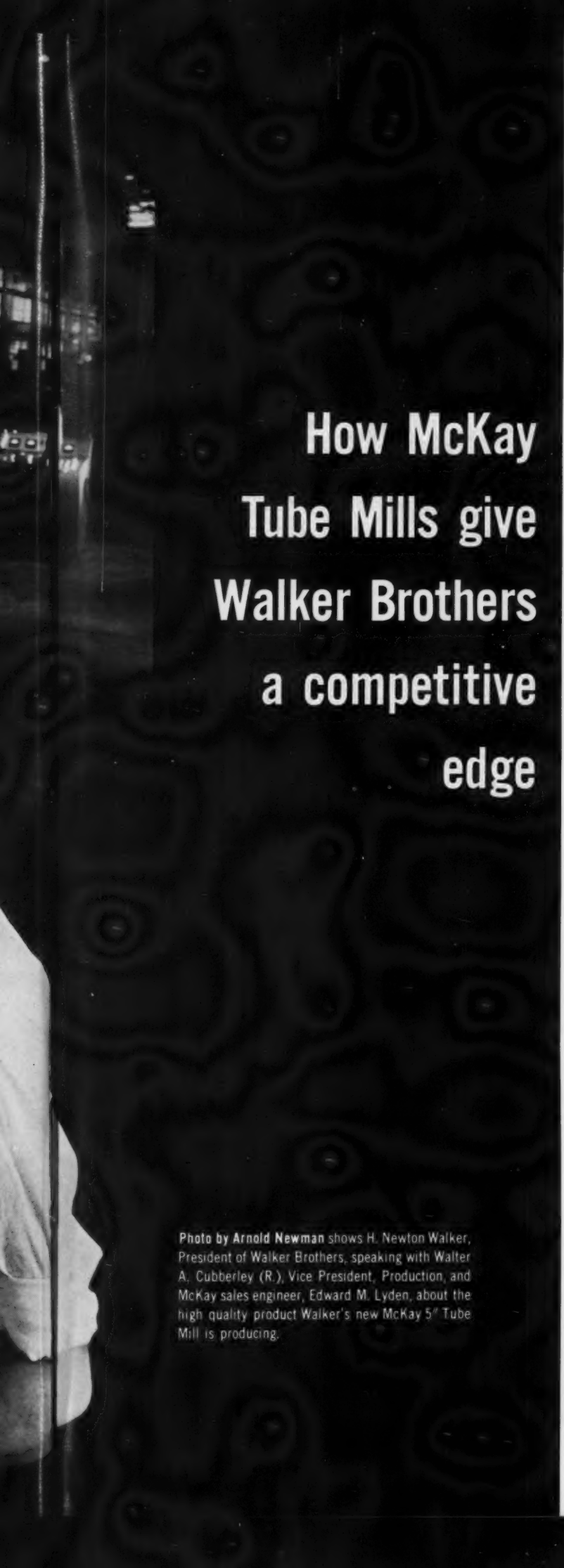
LOOK TO

McKAY MACHINE

FOR PROGRESS IN METAL PROCESSING

FOR EXAMPLE—McKay Pipe and Tube Mills are recognized to be the best conceived and finest constructed machines of their kind. On the next two pages H. Newton Walker, President of Walker Brothers, Conshohocken, Pa., gives a typical user reaction.

MCKAY



How McKay Tube Mills give Walker Brothers a competitive edge

Photo by Arnold Newman shows H. Newton Walker, President of Walker Brothers, speaking with Walter A. Cubberley (R.), Vice President, Production, and McKay sales engineer, Edward M. Lyden, about the high quality product Walker's new McKay 5″ Tube Mill is producing.

"Our new McKay 5″ Tube Mill enables us to extend our production range to the larger sizes of Walkerduct and steel tubing. The mill affords close manufacturing tolerances and improved control over production schedules," says H. Newton Walker, President of Walker Brothers, Conshohocken, Pa.

High Quality Product—Walker Brothers has been a primary supplier of high quality electrical distribution materials to the commercial and industrial construction industry for fifty years. "Walker of Conshohocken" products include building wire, power and control cables, mechanical steel tubing, steel electrical metallic tubing, rigid steel conduit and underfloor raceways.

"This is the third McKay Tube Mill we have installed since 1951 to increase our capacity to manufacture conduit and raceways," continues Mr. Walker. "Each of these mills," he says, "has turned out a product consistent with our high standards of manufacture."

Better Production Economies—Walker Brothers has, in addition to the new McKay 5″ Tube Mill, two 3″-capacity McKay mills equipped with strip looping and welding equipment. These mills are generally used to produce ½″ through 2″ thin wall conduit on a continuous basis at a speed of 150 feet per minute. The new 5″ mill also operates at 150 F.P.M. and at that speed can easily produce Walker's line of 6.5″ x 1.5″ x .076″ rectangular raceway.

Mr. Walter Cubberley, Vice President, Production, states: "We have been most satisfied with the performance of this equipment. Performance of the McKay mill has more than met our expectations regarding versatility and cost savings."

Low Maintenance Cost—"There's something to be said for the design of this equipment, too," he says, "in that maintenance is, and has been, satisfactorily low regardless of the age of the machinery."

"This is very solid equipment, including the welder. In fact, I would say these are the best mills we could have selected for our type of operation," Mr. Cubberley concludes.

McKay Machine designs and builds electricweld tube mills for high speed production of ferrous and nonferrous welded tubing up to 20″ in diameter. The experience of nearly 25 years of pioneering in the design of tube making equipment is behind each modern McKay Tube Mill.

Write for literature, or send a description of your needs for prompt quotation to McKay Machine Company, Youngstown 1, Ohio.

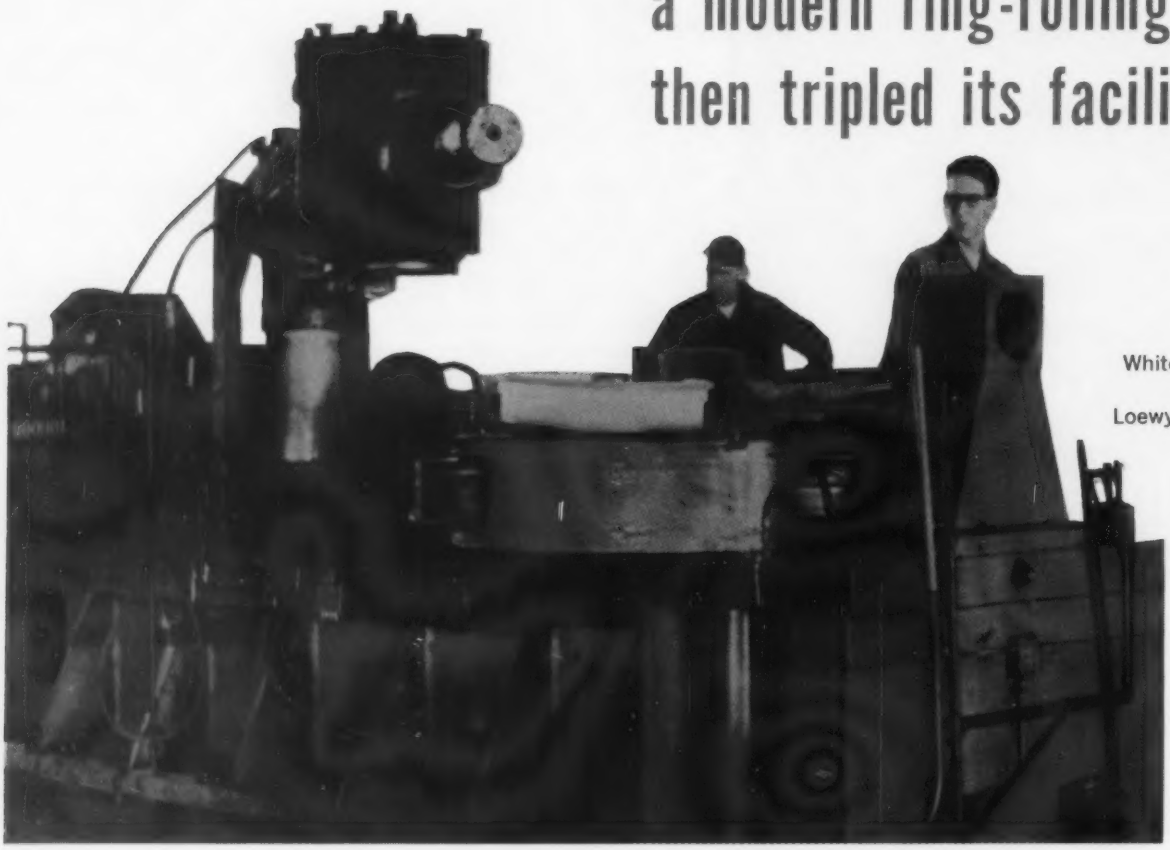
LOOK TO

McKAY MCK MACHINE

FOR PROGRESS IN METAL PROCESSING

One good "turn-key" deserves another...

Loewy built and equipped a modern ring-rolling plant, then tripled its facilities



White-hot jet engine ring on a Loewy ring-rolling mill

When the Navy needed rings to a number of unusual specifications for jet planes, a major supplier called upon Loewy-Hydropress to design and build a complete new ring-rolling plant and initiate production. Loewy developed several metal-forming methods, built the basic machinery, designed, constructed and equipped the plant, supplied the complete installation, organized the material flow, and put the plant into operation. Demand for the products quickly exceeded expectations and Loewy was commissioned the following year to triple the size and facilities.

In carrying out what amounted to two "turn-key" jobs, Loewy faced a number of challenging tasks. Navy specifications called for profile rings of alloy steels, stainless steels and titanium up to 72 in. in diameter and 9 in. high. Extruded bar stock and centrifugal castings were to be the basic materials. With these requirements as the goal, Loewy went to work.

Process engineering was confronted with problems not met before, but Loewy metallurgists, together with heat-treating and rolling mill specialists, solved them all, designing the installations to difficult requirements.

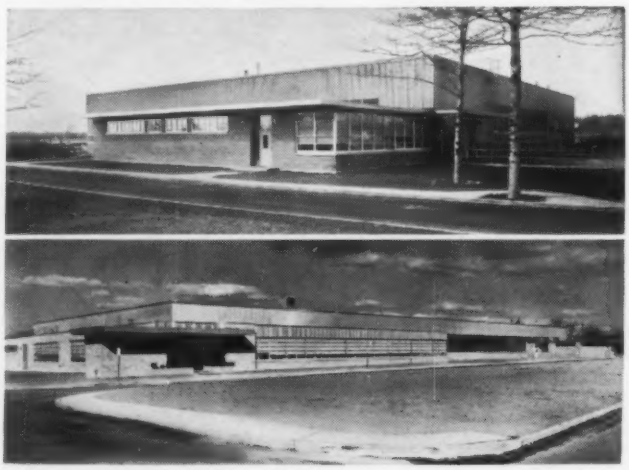
It was also Loewy's task to find the best location for the plant. The site chosen, despite its advantages, presented certain physical obstacles, such as streams which had to be diverted or channeled underground. While machinery and auxiliaries were being built, the building and equipment foundations, designed by Loewy, were poured, and the structure rose.

Latest type machinery was then installed for bending, resistance welding, blank heating, annealing, heat treating, ring rolling, expanding, shrinking, shotblasting and machining. Intricate ventilation and fire-protection systems were installed. The most modern quality-control and metallurgical equipment were integrated into the system.

All deadlines were met. Both the initial plant and the vastly expanded facilities went into production on schedule.

If the swift march of technological progress and the pressure of competition urge you to make new products by new processes—in any industrial facility, large or small—take into account what Loewy can do for you. Contact Dept. C-6.

The initial ring-rolling plant

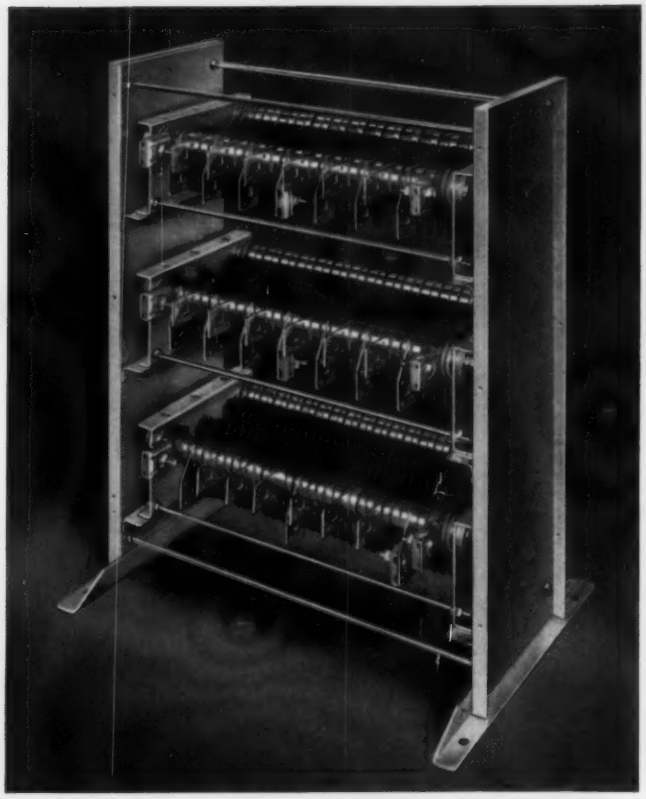


The expanded plant

BALDWIN · LIMA · HAMILTON
Industrial Equipment Division • Philadelphia 42, Pa.

POST-GLOVER RESISTORS...

Racked to suit the application!



Plain Racks without enclosure

Racks with solid or expanded metal tops

Racks with louvered or expanded metal sides

P-G the ORIGINAL Steel Grid Resistor

Made of steel and mica, nothing to break, plus P-G unique and exclusive grid design, these resistors afford maximum protection to vital equipment. They are rugged, nonbreakable, shock resistant, and have proved their merit in all kinds of service for over 20 years.

P-G Resistor Racks are available for all P-G Resistors in units from two to eight resistors high. If other than standard racks are more suitable, special racks can be furnished to suit the application. Ventilation is achieved through louvered or expanded metal panels as desired, both easily removable with only a screw driver. P-G Racks may be shipped complete with resistors mounted, with or without enclosure, or knocked down to save shipping space. For further data about P-G Resistors and Racks, write us of your needs.

The Nonbreakable Steel Grid Resistor

P-G

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THE **POST-GLOVER** ELECTRIC COMPANY

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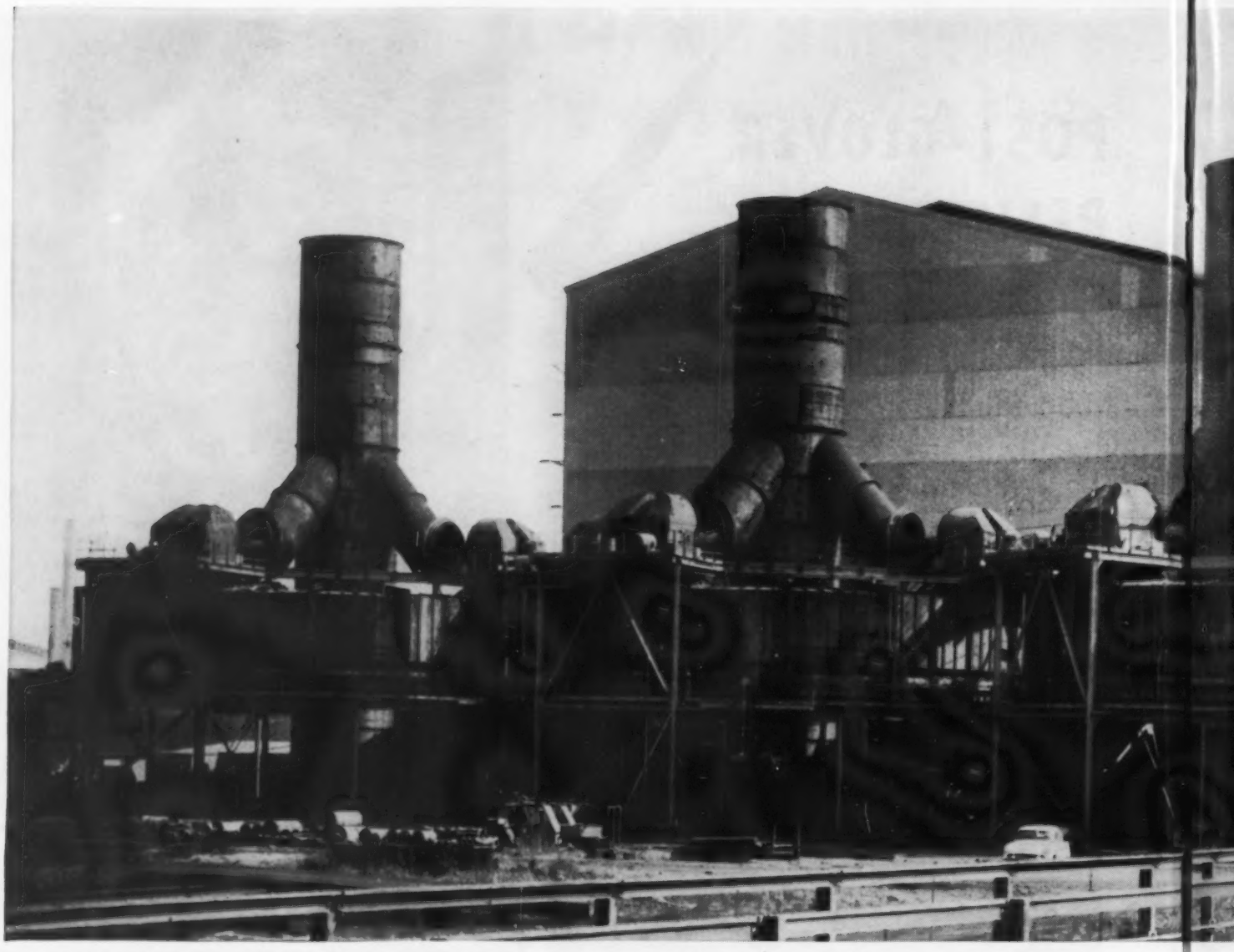
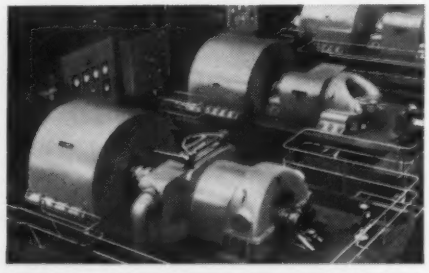


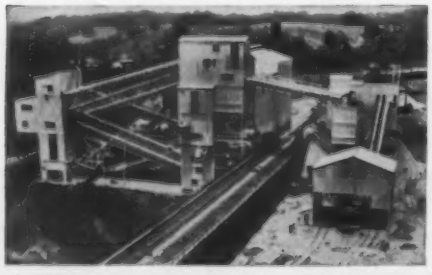
One of two 15,000 ton per day Dravo-Lurgi sinter plants. Each plant contains three sinter machines, and is rated among the largest in the world.

Dravo-Lurgi sinter plant, ore bridges, dock, boiler plant, pump house and waste treatment facilities are included in engineering-construction for this mid-west steel mill.

Dravo-built power plant produces electric power and high pressure steam for mill supply. Contract included piping steam and blast furnace gas to and from the plant.

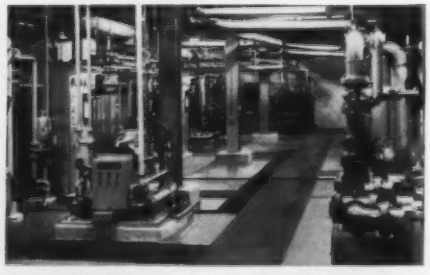


Part of a Dravo power plant project, these three DeLaval turbo-blowers produce 290,000 cfm of standard air for a major steel company's blast furnaces.

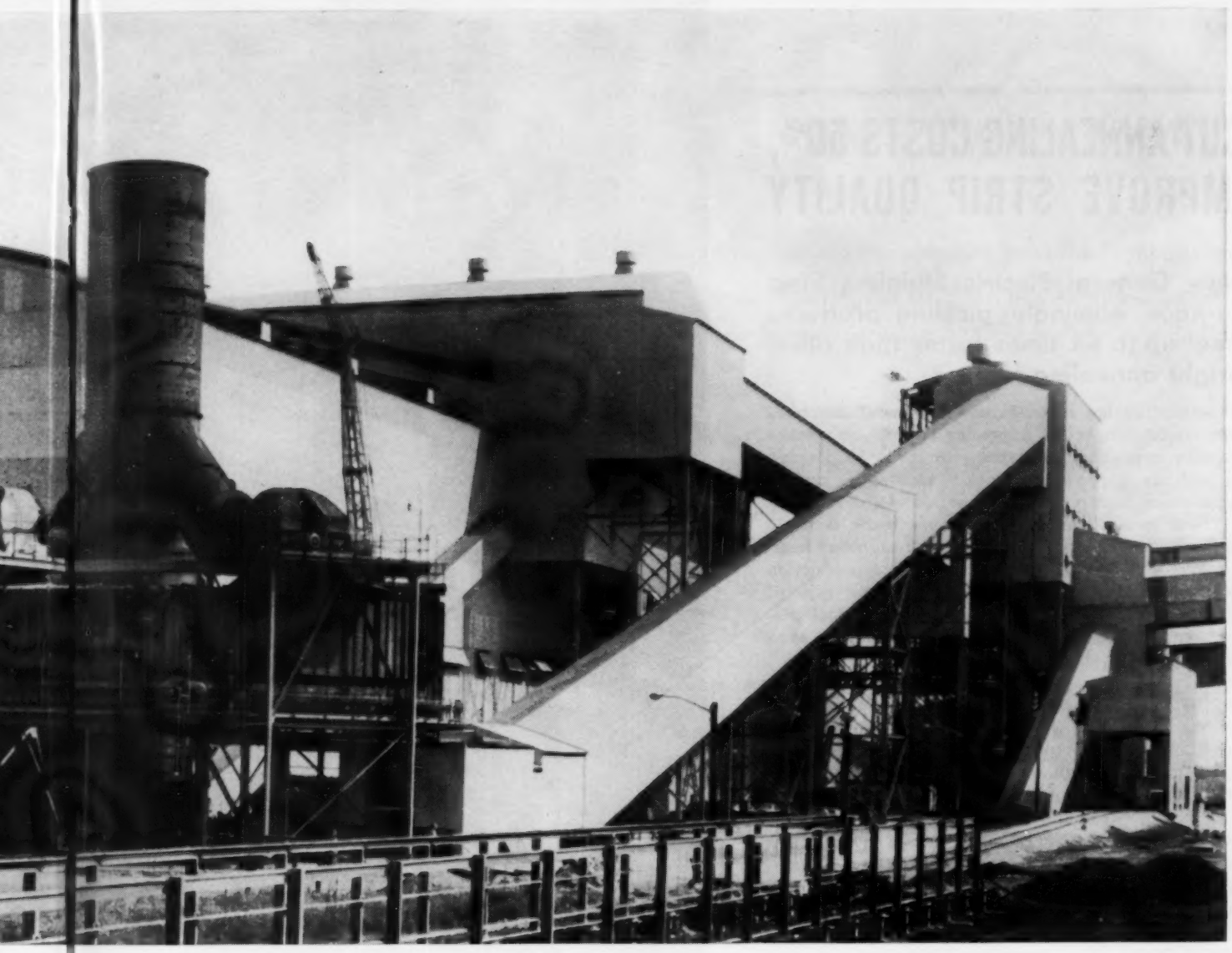


A 2400 ton per day Dravo-Lurgi sinter plant constructed by Dravo. Materials handling system is designed to receive and store a day's supply of raw materials in eight hours.

Blast furnace flue dust recovery plant includes two 105-foot Walker Process Thickeners. Other Dravo projects include pumping stations, water treatment and waste disposal plants.



Automatic Dravo-DeLaval mill lubrication system, circulating a total of 45,200 gallons of oil at 556 gpm, protects one of the world's fastest 10-inch rod mills.



Turn-key Construction for the Steel Industry

sinter plants • power plants • materials handling • mill lubrication
water clarifying and pumping stations • harbor facilities • piping

Dravo's ability to handle turn-key projects is the result of wide engineering-construction experience together with an intimate understanding of steel industry problems. Working to your operating requirements, Dravo assumes overall responsibility for engineering, procurement of equipment and erection of the complete facility.

With this type of single responsibility contract, customer's executive time is conserved, and, since engineering and construction are integrated, the project "gets done" on time.

Your next expansion or replacement project can benefit in terms of final cost and time saved from the type of teamwork that Dravo experience makes possible.

For more information, write or phone DRAVO CORPORATION, Pittsburgh 22, Pennsylvania.

DRAVO
CORPORATION

CUT ANNEALING COSTS 50%, IMPROVE STRIP QUALITY

New General Electric Stainless Strip Furnace* eliminates pickling, produces steel up to six times faster than other bright annealing furnaces.

Important design innovations on General Electric's new continuous bright annealing furnace now make possible annealing cost reductions up to 50 percent, as well as improved corrosion resistance, surface appearance, and physical properties of the strip.

These money saving benefits are made possible by the new design principles of *direct radiation heating* and *jet cooling*, which allow faster production speeds than ever before possible with this type of furnace. The furnace can achieve such typical production rates as 7700 lbs/hr of 24-inch strip, even more for wider strip.

FASTER HEATING—The new heating section design utilizes molybdenum units mounted on high-purity brick, backed by a special insulation. Heating is by direct radiation without muffles. Thus, faster, more uniform heating is achieved.

FASTER COOLING—Jet coolers, driven by gas-tight motors, direct streams of hydrogen at right angles against the strip for faster, uniform cooling with minimum grain growth and carbide precipitation.

LOWER COSTS—Less downtime is required, no metal muffles are needed, and you get up to six times more production, compared with other bright annealing furnaces. There's no acid maintenance, replacement, or disposal as in conventional anneal and pickle operations. Annealing costs can thus be reduced as much as 50 percent.

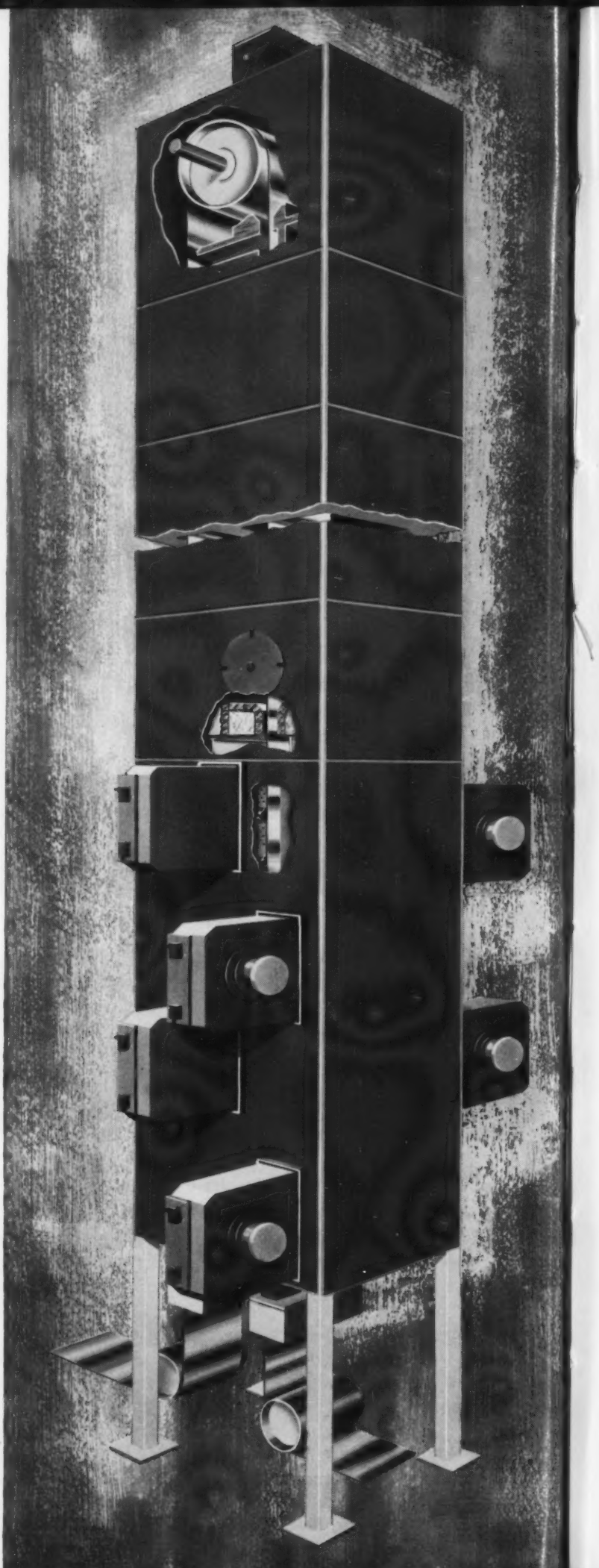
HIGHER QUALITY STRIP—Vertical construction reduces hot strip tension and improves appearance. Since furnace has only one roll which does not touch hot strip, surface scratching is eliminated. Faster heating and cooling rates also improve corrosion resistance and physical properties.

Find out today how the new General Electric Stainless Steel Furnace can increase production, improve strip quality, and save you money in your annealing operations. Contact your G-E Sales Engineer, or write for new bulletin GED-4124. General Electric Co., Schenectady 5, New York. 756-03

* Patents Pending.

Progress Is Our Most Important Product

GENERAL ELECTRIC



patent reviews

By MELVIN NORD, Patent Attorney, Detroit, Mich.

Copies of patents may be obtained from the Commissioner of Patents, Washington 25, D.C. at 25 cents . . . patents reviewed cover period January 5, 1960 to February 2, 1960.

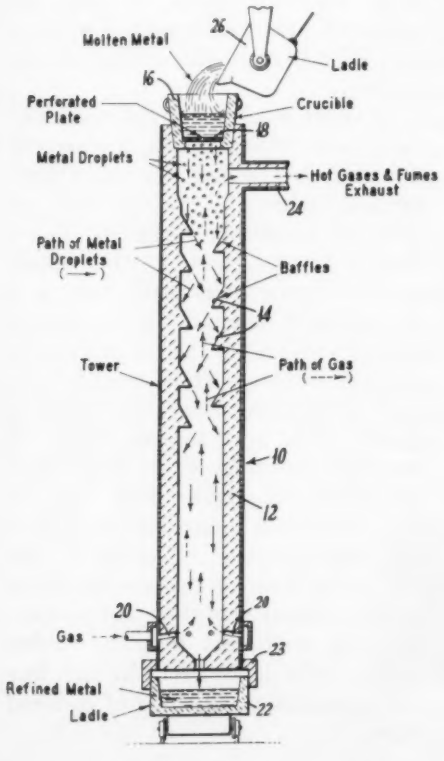
REFINING MOLTEN PIG IRON

△ U. S. 2,915,380, issued Dec. 1, 1959, to Donald C. Hilty and assigned to Union Carbide Corp., describes a process for refining molten pig iron.

As shown in Figure 1, a tower 10 having a refractory lining 12 is open at both ends. Baffles 14 are provided on the tower walls. On the upper end of the tower 10 rests a crucible 16 having a removable, perforated bottom plate 18 of graphite or aluminum oxide. Near the tower bottom are a number of tuyeres 20 for admitting oxygen, and below the open bottom end is a receiving ladle 22 for collection of treated iron. To prevent escape of smoke and metal, a sealing member 23 is provided between the ladle 22 and tower 10. An outlet 24 for exhaust gas, smoke and fume is provided near the top of the tower 10.

In the practice of the invention, molten pig iron to be treated is poured from a ladle 26 into the crucible 16 from which it passes through the perforated plate 18 which assists in the formation of discrete droplets. The droplets fall freely into the tower 10. Oxygen is admitted through the tuyeres 20 and flows parallel but countercurrent to the path of the falling droplets. The treated metal is collected in the receiving ladle 22, and exhaust gas, smoke and fume pass out the outlet 24.

Figure 1



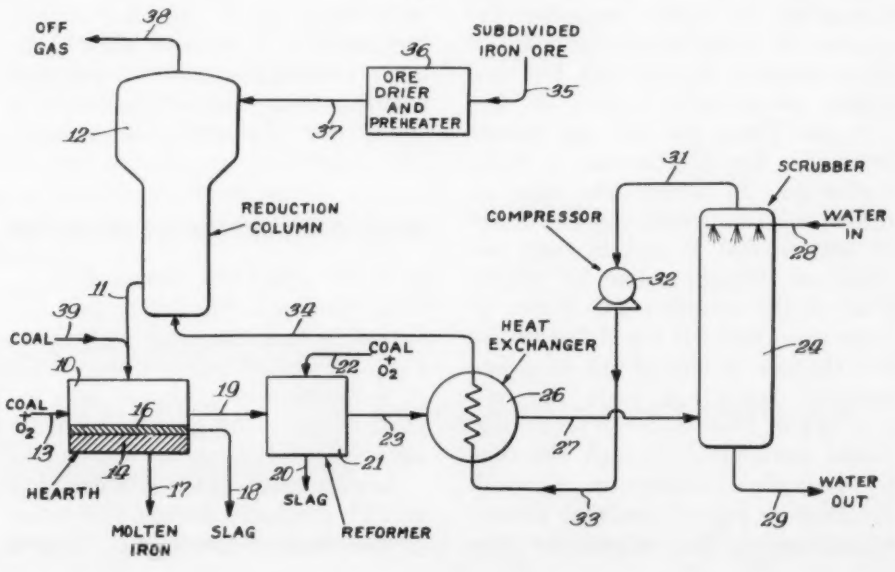
DIRECT REDUCTION OF IRON ORE

△ U. S. 2,919,983, issued Jan. 5, 1960, to James W. Halley and assigned to Inland Steel Co., describes a process for the direct reduction of iron oxide ores, by the use of a reducing gas consisting principally of carbon monoxide and hydrogen.

As shown in Figure 2, iron ore is reduced in a countercurrent reduction column 11. The reduced iron ore is then fed to hearth 10, where coal is burned with oxygen introduced as a preformed mixture at 13. The combustion conditions are regulated to provide an oxidizing atmosphere wherein the combustion gas has a CO_2:CO ratio of from about 0.7 to about 3 and the temperature in the hearth 10 may be from about 2900 to about 3500 F. Molten iron 14 and slag 16 may be withdrawn from the hearth 10 as desired through lines 17 and 18, respectively.

The combustion gas from the hearth 10 passes through a line 19 to a coal gasifier or reformer 21 to which oxygen and an excess of coal are supplied through a line 22. The carbon in part of the coal supplied at 22 reacts with the CO_2 in

Figure 2



the combustion gas supplied at 19, and the endothermic heat requirements for the reduction reactions are furnished by the sensible heat in the combustion gas supplemented by additional heat evolved in the reformer 21 by combustion of another part of the coal supplied through the line 22. Since coal is burned in the reformer 21, residual ash is left, some of which may be removed through a line 20 as a liquid or semi-solid slag and the remainder of the ash is carried out by the exit reformed gas through a line 23. The extent of reforming carried out in zone 21 must be sufficient so that the reformed gas removed through the line 23 contains not more than about 10 per cent CO_2 with a $CO:CO_2$ ratio of at least about 7, and preferably not more than about 5 per cent CO_2 with a $CO:CO_2$ ratio of at least about 10. Furthermore, the $H_2:CO$ ratio in the gas removed at line 23 should not be greater than about 1 and preferably not greater than about 0.5.

Because of the endothermic reactions carried out in the reformer 21, the temperature of the reformed gas is substantially lower than the temperature of the hearth gas, e.g., the CO-rich gas discharged at 23 may be at a temperature of from about 1900 to about 2400 F. Before this gas can be employed in the reduction column 12, it must be cooled still further and must also be treated for the removal of entrained coal ash. Although a gas cleaner such as a cyclone separator or an electrostatic precipitator may be used to effect removal of ash, the drawing shows, by way of illustration, a water scrubber or washer 24 which effects quite complete removal of coal ash but requires preliminary cooling of the hot gas. Thus, the hot gas passes from the line 23 through a heat exchanger 26 where the gas is cooled to a temperature on the order of 500 to 600 F and is then introduced through a line 27 to the base of the scrubber 24. Water is introduced into the top of the scrubber through a line 28 for countercurrent contacting with the reducing gas. If desired, the scrubbing liquid introduced through the line 28 may also comprise a chemical reactant or solvent such as monoethanolamine for selectively removing further amounts of CO_2 from the gas. The effluent scrubbing liquid is removed from the scrubber 24 through a line 29 for discard, recirculation or recovery treatment, as the case may be.

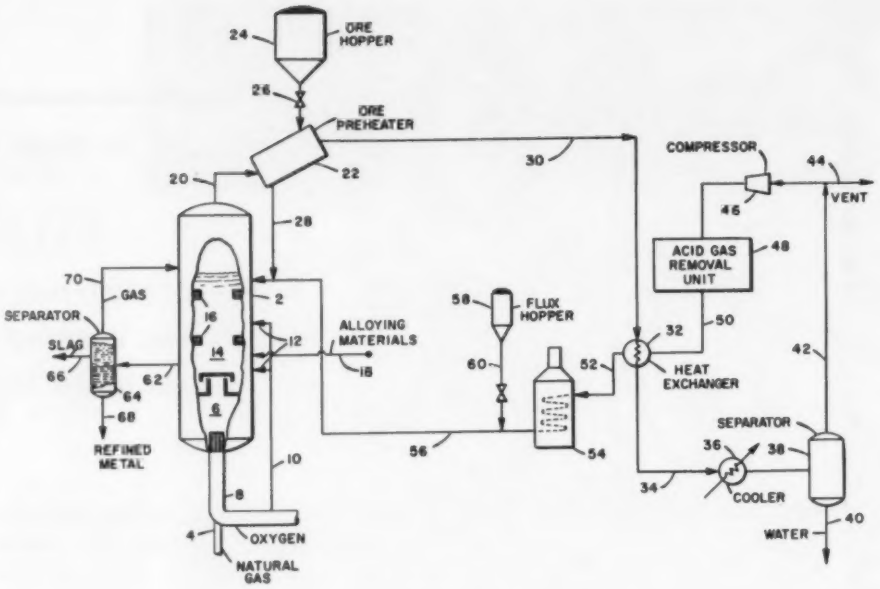


Figure 3

For the practical reasons of simplifying the hearth construction and facilitating access to the hearth, it is usually preferred that the hearth zone 10 be operated at substantially atmospheric pressure. Under such circumstances, it is necessary to provide a gas pump or compressor in the system for effecting passage of the gas through the various stages of the process and particularly through the reduction column 12. Thus, the effluent clean reducing gas from the scrubber 24 passes through a line 31 to a compressor 32 and then through a line 33 to the heat exchanger 26 wherein the previously cooled and cleaned gas is reheated to a suitable reaction temperature of from about 900 to about 1800 F. The reheated reducing gas then passes through a line 34 to the bottom of the reduction column 12.

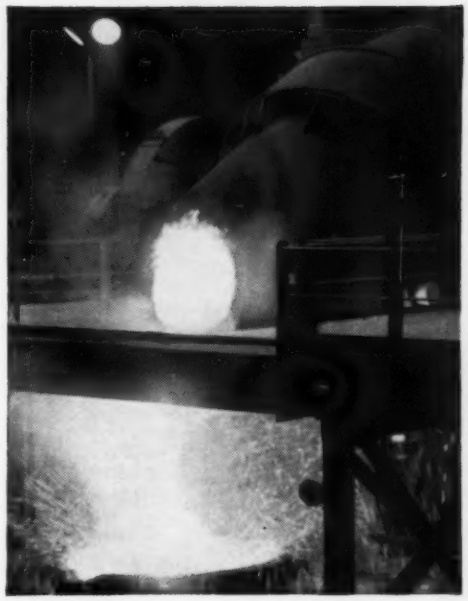
DIRECT REDUCTION OF IRON ORE

△ U. S. 2,923,615, issued Feb. 2, 1960, to Frank G. Pearce and assigned to Pan American Petroleum Corp., provides a one-step process of reducing iron oxide ore into refined metal, using gaseous reducing agents instead of coke.

As shown in Figure 3, the smelting unit 2 is originally charged with scrap or pig iron. Natural gas charged through pipe 4 is burned in open combustion zone 6 with substantially pure oxygen added through pipe 8 to produce carbon monoxide and hydrogen at a temperature of about 3000 F. The oxygen and natural gas are charged to the combustion zone at high velocities, e.g., 100 to 400 fps, to insure complete and rapid mixing. Introduction of these gases in this manner and in a ratio of about 0.55 to about 0.7 mol of oxygen per mol of natural gas (calculated as methane) provide conditions resulting in a minimum of carbon formation. The heat from the resulting hot combustion products, together with oxygen introduced into the system via lines 10 and 12, melt the initial charge of iron.

In order to obtain a substantially oxide-free refined metal, a smelting unit is used which has compartmented zones 14 defined by reinforced refractory slabs 16. These compartments permit the gases to rise through the bath but tend to minimize the mixing of liquids except within a given compartmented section. Thus, countercurrent contacting of the reducing gases with the molten bath is secured resulting in a high concentration of oxide and flux in the uppermost compartment and a low concentration of oxide in the bottom section of the smelter from which refined metal is withdrawn. Alloying materials may be added to the bath, if desired, through line 18 to permit production of finished steel.

THE NOURISHING GAS



TO THE CHINESE
OXYGEN IS THE NOURISHING GAS.

To steelmakers in Britain and elsewhere, benefiting from the introduction of new oxygen steelmaking processes, the name couldn't be more apt. Oxygen is being increasingly used in the iron and steel industry. A converter furnace, employing oxygen for the blast instead of air, not only makes steel quicker than any other furnace, it produces steel of improved quality as well. Use of oxygen also enables the design of converter furnaces of much greater capacity, which means an installation of lower cost for any given output tonnage. Similar benefits accrue with any other steelmaking furnace. Faster production, better quality, reduced capital costs—strong nourishment in any language.
The design, engineering and supply of oxygen steelmaking plant up to complete melting shops is the main concern of Davy United's Steel Processes Division. In support of these services, the Division offers metallurgical, technical and economic surveys to help any company planning a new steelmaking development.

DAVY-UNITED STEEL PROCESSES DIVISION

SHEFFIELD, ENGLAND

To Meet Customer Demands

New Side Trimming Line Installed In Tin Mill Will Improve Production Of Tinplate In Coils

Installation Called Most Modern Of Type In Industry

A new side trimming line to facilitate the production of tinplate in coils in Weirton Steel's Tin Mill Department was placed in operation recently.

W. H. Wright, Vice President and Chief Engineer, said the new installation, rated among the most modern pieces of equipment in the steel industry, was installed because of the increasing demand from customers for tinplate in coil form. The company will also continue to ship tinplate in the conventional cut sheets.

The new side trimming line, which began operating last month, and a second line, installed on an emergency basis, are used to trim the sides of the sheet steel before it is plated with tin, so it can be wound into coils and be ready for shipment as it comes off the tinning lines.

Mr. Wright explained that Weirton Steel's No. 4 and No. 5 tinplating lines have been equipped with edge control reels which insure that each coil is wrapped with a straight edge. This is necessary to prevent damage to the edges in bundling and shipping and also because straight edges are required when the coils are processed further by Weirton Steel customers.

Mr. Wright also reported the installation of a new bundling line, which began operating about three months before the new side trimmer. The bundling line utilizes machinery to wrap coils in heavy paper and fasten them with steel straps. Formerly, this was a hand operation.

The side trimming operation takes place after the steel has been tempered to customer specification by the skin mills and before it is plated with tin. This process eliminates the waste which formerly resulted when the side trimming was done on the cutting lines, after the tinplating process.

The No. 2 side trimming line has a maximum speed of 4,000 feet per minute while the No. 1 line operates at a speed of 1,200 feet per minute. The No. 2 line is able to handle 30-ton coils 85 inches in diameter and 45 inches wide. The line also is equipped with a mash welder, a relatively new operation which provides a smoother weld that does not damage other sections of the coil as it is wound.

All of the new facilities were designed by the Weirton Steel Engineering Department and installed by the company's Construction Department.

Reprinted from Employees Bulletin, Weirton Steel Company, February, 1960

Due to increasing demands from customers for tinplate in coil form, a new side trimming line was installed recently in the Tin Mill. The new trimming line, designed by Weirton Steel's Engineering Department and installed by the Construction D[illegible] the [illegible] of sheet steel bef[illegible]ted with ti[illegible]

Once again—

proof that GPE Controls is the Steel Industry's "Partner in Progress"

The tin mill side trimming line at Weirton Steel Company, Division of National Steel Corp., was furnished by Wean Engineering Co., and equipped with the industry's most modern edge guide equipment—designed and built by GPE Controls, Inc.

Only GPE Controls offers steel mill edge guides with . . .

★ Non-clogging sensing nozzles with lowest air consumption.

★ Unlimited force output with cylinder pressures to 2000 p.s.i., flows to 140 g.p.m and higher.

★ Variable-gain booster for simple screwdriver job-site matching of control system to speed, coil weight, etc.

Write for NEW Bulletin EG84, which tells all about GPE Controls web guiding systems—and be sure that GPE Controls are specified and furnished on your next strip and tin mill installation.

GPE Controls Model 300 Edge Control, as furnished to Weirton Steel Company.

GPE Controls, Inc.
240 East Ontario Street
Chicago 11, Illinois

GPE Controls — A GENERAL PRECISION COMPANY

A subsidiary of General Precision Equipment Corporation

Hot gases are taken overhead from the smelter through line 20 and introduced into ore preheater 22. The latter is fed from ore hopper 24 with the flow of ore to the preheater being controlled through valved line 26. The heated ore is removed from preheater 22 through line 28 and joins the charge of carrier gas and flux going into the smelter via line 56. Hot effluent gases from ore preheater 22 generally consist principally of carbon dioxide, hydrogen sulphide, steam, carbon monoxide and hydrogen. This hot gaseous stream is taken through line 30 at a temperature of from about 800 to about 1500 F, run through heat exchanger 32, line 34, then cooler 36 and transferred to separator 38 where liquid water is removed through line 40. Uncondensed gases, which are now at a temperature of about 100 F, are transferred through line 42 where a minor portion is vented through line 44 to purge the system of inert gas and the remainder compressed to form about 100 to 400 psi (about smelting unit pressure) in compressor 46. Acidic gases in the compressed stream, such as carbon dioxide and hydrogen sulphide, may be separated from the carbon monoxide and hydrogen by running said stream through an acid gas removal system 48, diagrammatically shown, and the resulting acid gas-free stream sent through line 50 where it picks up heat in exchanger 32 from hot gases flowing through line 30. The preheated stream is then taken through line 52 to direct fired heater 54, heated to about 1400 F and is used as a carrying medium in line 56 for flux in hopper 58. Flux fed to line 56 through valved line 60 is then transferred in the desired amount through line 56 and continuously introduced with preheated ore, as described above, into molten bath 14. The mixture of ore and flux is trapped in the bath and rapidly melts. The ratio of fresh reducing gases generated in combustion zone to the reducing gases returned to the system via line 56 generally may range from about 0.5 to 2.0.

A mixture of slag and refined iron is continuously withdrawn from the smelter through line 62 and transferred to a separator 64. A slag layer forming on top is continuously withdrawn through line 66 while refined metal is removed through line 68. Gas from the separator is taken overhead through line 70 and returned to the smelter at a level above the surface of molten bath 14.

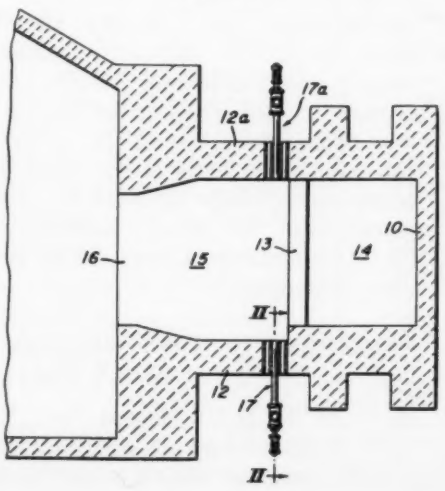
METHOD OF FIRING OPEN HEARTH FURNACES

△ U. S. 2,920,692, issued Jan. 12, 1960, to Robert G. Renninger and Kenneth C. Shearer, assigned to United States Steel Corp., describes an improved method of firing side-fired open hearth furnaces.

Figure 4 shows a portion of a side-fired reversible open hearth which includes an end wall 10, opposed side walls 12 and 12a and a bridge wall 13. An air uptake 14 is situated between the bridge wall and end wall and is adapted to introduce preheated air which flows in a direction parallel with the length of the furnace. When the furnace is fired from the other end, this uptake becomes a downtake for waste gases in accordance with usual practices. The side walls inwardly of the bridge wall define a throat 15 and a port 16, beyond which the bath is located. The side walls 12 and 12a contain burners 17 and 17a which are located immediately inwardly of the bridge wall. The same structure is duplicated at the other end of the furnace.

Figure 5 shows the burner 17 in more detail, the other burner 17a being similar. Burner 17 comprises a low velocity gas inlet pipe 18 and a concentric high velocity gas inlet pipe 19 positioned inside the former pipe by a spider 20. The pipe 17

Figure 4



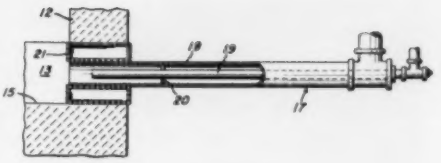


Figure 5

is mounted in a conventional water cooled block 21 set in the side wall 12.

When the open hearth is heating up, for example during a melt-down period, combustible gas is introduced through both the low and high velocity gas inlet pipes of both burners 17 and 17a at the end of the furnace from which it is currently being fired. In the furnace throat 15 this combustible gas mixes intimately with preheated air from the uptake 14 and burns completely over the charge with a relatively short sharp flame. Once the furnace attains its maximum temperature, the high velocity gas is cut off, and the low velocity gas alone burns with a long uniform flame to heat the furnace and its charge. If at any time subsequently more heat is needed, the high velocity gas again can be turned on.

APPARATUS FOR COOLING MILL ROLLS

△ U. S. 2,921,488, issued Jan. 19, 1960, to Floyd E. Davis and assigned to United States Steel Corp., describes an apparatus for cooling and work rolls in sheet and plate rolling mills.

In Figures 6 and 7, the numerals 1 and 2 designate the upper and lower work rolls and the numerals 3 and 4 designate the backup rolls in rolling engagement therewith. Each of the rolls has a conventional mounting in a mill stand housing (not shown) and the rolls 1 and 2 define a working pass between which strip or plate is rolled from right to left as viewed in Figure 6 upon rotation in the direction indicated by the arrows. The surfaces of the upper set of rolls 1 and 3 define a pair of troughs 5 which are essentially V-shaped and which face outwardly in opposite directions from their line of rolling contact which is designated in Figure 7 by the numeral 6. The lower set of rolls 2 and 4 similarly defines a pair of V-shaped troughs 5 facing outwardly from their line of rolling

contact. Identical spray assemblies, respectively designated as a whole by the numeral 7 are provided for spraying each work roll surface 8 which forms one side of a trough 5.

Each spray assembly 7 comprises a header or manifold pipe 10 which has a water supply connection 11 at its center and closure caps 12 at its ends. Each of the pipes 10 is mounted in a position opposite one of the troughs 5 with its axis parallel to the roll axes and has brackets (not shown) at its ends by which it is supported in a conventional manner on the mill stand housing. A number of nozzle assemblies, respectively designated as a whole by the numeral 13, are provided at uniform intervals along the length of each pipe 10.

The conduits 10 supply water to the nozzle assemblies 13 which respectively project a flat fan-shaped jet of water against a trough surface 8 in the direction shown in Figure 6. When the jets of water strike the working roll surface 8, the water is deflected and moves inwardly over the working roll surface 8.

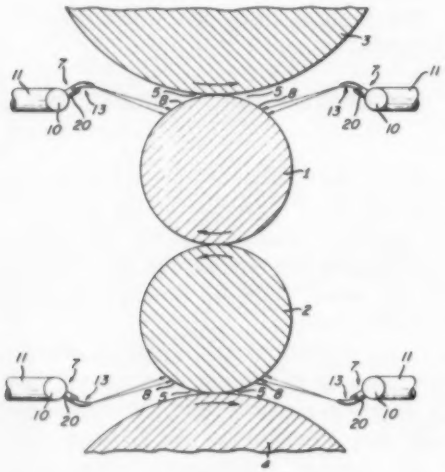
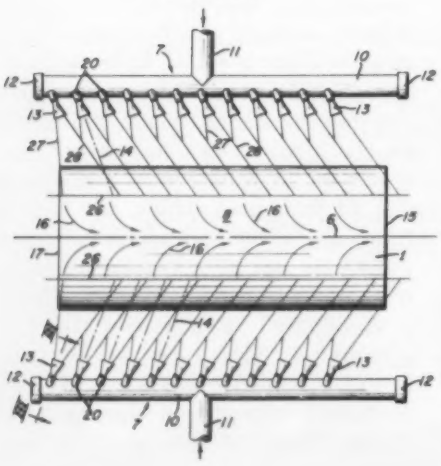


Figure 6

Figure 7



OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or assignee
2,919,466	1/ 5/60	Feeding chute for metal powder rolling mill	Hoegenaes Sponge Iron Corp.
2,919,867	1/ 5/60	Wire coiler	United States Steel Corp.
2,919,982	1/ 5/60	Pretreatment of ilmenite ore	Quebec Iron & Titanium Corp.
2,920,769	1/12/60	Cover operating mechanism for soaking pits	Howard F. Spencer
2,920,838	1/12/60	Strip coiling apparatus	United Engineering & Foundry Co.
2,920,839	1/12/60	Coil handling mechanism	Wean Equipment Co.
2,920,954	1/12/60	Stainless steel alloy of high hardness	Cooper Alloy Corp.
2,920,955	1/12/60	Aluminum-iron alloy	Ford Motor Co.
2,921,365	1/19/60	Device for descaling and cleaning wire rod	Earl C. Planett
2,921,699	1/19/60	Charging apparatus for rod mills	Republic Steel Corp.
2,921,849	1/19/60	High strength alloy steels	Ladish Co.
2,922,175	1/26/60	Tuyere punches	Willem J. DeVilliers et al.
2,922,206	1/26/60	Chill mat for ingot molds	William E. Schmertz
2,922,207	1/26/60	Method for producing ingot mold stool	George A. Radu, Jr.
2,922,325	1/26/60	Four-roll rolling mill	Gesellschaft der Ludw. von Roll'schen Eisenwerke A. G.
2,922,713	1/26/60	Magnesium bearing cast iron	William H. Moore
2,923,187	2/ 2/60	Tube rolling mill	Fritz G. Bengtsson
2,923,617	2/ 2/60	Refining ferrosilicon	Jorgen A. Kolflaath
2,923,619	2/ 2/60	Wear resistant steel	The Carpenter Steel Co.

By reason of the angular inclination of the nozzle assemblies 13 toward the roll end 15, the water from each jet moves in the direction indicated by the arrows 16 and in a direction axially of the roll 1 toward its end 15. While the axial force produced by each of the jets adjacent the roll end 17 is insufficient to carry the water from such jet to the end 15 of the roll 1 and would otherwise gravitate downwardly over the surface 8 of the roll after its axial force was overcome, each succeeding jet forces the water from a preceding jet inwardly into the trough 5 and moves it with a boosting action toward the end 15. In this manner, streams of water are produced in each trough 5 which flow from the roll end 17 to the roll end 15 and are discharged from the work roll surface at the end 15. Due to the accumulating effect of the water from the nozzles 13, such streams have a size which progressively increases in the direction of stream flow from the roll end 17 to the roll end 15, the water in the streams being continuously replaced by the water from the nozzle assemblies 13 at uniformly spaced intervals along its length.

ELECTROLYTIC TREATMENT OF BLACK PLATE

△ U. S. 2,920,019, issued Jan. 5, 1960, to Edwin J. Smith and John R. Smith, assigned to National Steel Corp., describes a method of electrolytically treating black plate for improvement of its corrosion resistance and lacquer adhesion properties.

The black plate is anodically treated in an aqueous acidic bath containing 1 to 15 ounces per gal of sodium dihydrogen phosphate. This treatment provides satisfactory phosphate films on the black plate.

COKE GUIDE OPERATED CONTROL SYSTEM FOR PUSHER RAM

△ U. S. 2,923,422, issued Feb. 2, 1960, to Michael J. Macey, assigned to United States Steel Corp., provides an apparatus for stopping a pusher ram when a charge of coke sticks in a guide, which is not dependent on the observation and reaction of an operator for its operation.

ULTRASONIC QUENCHING OF STEEL ARTICLES

△ U. S. 2,920,988, issued Jan. 12, 1960, to Thomas J. Bulat and assigned to Bendix Aviation Corp., provides a method for eliminating the vapor blanket which tends to form at the surface of hot steel being quenched.

This is accomplished by passing ultrasonic waves through the liquid at an energy level sufficient to produce cavitation at the surface of the steel objects during their removal from the quenching liquid.

Stub at left shows average waste with conventional cutting carbons; piece at right shows small amount of waste with Kostkutter Rods.

"We save 20 to 25% over conventional cutting carbons with Speer's new KOSTKUTTER RODS*"

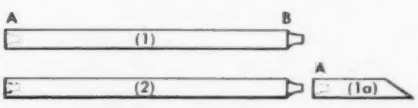
says Benjamin Desper, Cleaning Room Foreman, Atlantic Steel Castings Co., Chester, Pa.

You can save money too! The revolutionary design of Kostkutter Rods, a Speer development, allows the joining of the normally discarded 2½ to 3 inches "waste" to the front of the next rod for further use. Additional savings are realized due to reduced torch damage. It is no longer necessary to economize by burning carbons close to the clamp, bringing the torch too near the hot spot. Additional "left over" carbon is used up with the next rod. This virtually eliminates stub loss. It is important to note that Kostkutter Rods are copper plated (except for the tapered sections) after shaping the rod ends, thereby insuring perfect contact between rods.

Kostkutter Rods are available only from Speer. Buy them in diameters of ½", ⅝", ¾" and 1". Standard cutting carbons are also available at slightly lower prices.

How Kostkutter Rods Save You Money

Each Kostkutter Rod has a tapered hole in one end (A) and a tapered projection at the other end (B) as shown in Diagram 1. The rod is clamped into the torch and used in the normal way. The stub end (Diagram 1a) which, with conventional cutting carbons would be wasted, is removed from the torch and attached to the end of a new Kostkutter Rod (Diagram 2). The tapered end of the new rod slips easily into the tapered hole at the end of the stub and is held firmly by friction. The new rod, with the stub attached, is then clamped into the torch and practically the entire stub is used up instead of being discarded.



SPEER Carbon Co.
Carbon Products Division • St. Marys, Pa.

*Patent applied for

Photo courtesy Jones & Laughlin Steel Corporation

Nozzle is key to economy as open-hearth men turn to O_2 to step up furnace output

. . . NBD reports on refractory life, fuel consumption, heat time and lance maintenance as affected by the O_2 nozzle

The injection of pure O_2 into the open hearth is experiencing near-phenomenal growth. The reasons: lower steel costs . . . reductions in heat time . . . fewer man hours per ton of steel . . . marked fuel savings.

At the same time, however, oxygen injection is raising new problems. And because each producer must face these problems in the light of his specific furnace conditions, the net gains to producers vary.

Among the factors calling for special attention are: fume control, refractory life, scheduling and traffic control, and lance maintenance.

Nozzle Is Key To Economy

NBD has been studying the use of O_2 in the open hearth since its early experimental stages. An 80-year-old veteran in supplying steel's bronze and copper needs, NBD has had its national network of technical representatives observing and reporting on the oxygen process.

The most important conclusions derived from these observations are:

OXYGEN DISPERSION—The degree of interaction of oxygen, slag and steel controls heat time and fuel consumption. Slag splash and its effect on refractory life are directly related to the violence of the mixing action.

NOZZLE LIFE—Teeming, transportation, stripping and rolling schedules are dependent on the reliability and service life of the nozzle. Erratic nozzle life, or off-schedule taps due to nozzle failures, can cut seriously into the economic gains possible with O_2 injection.

Maximum dispersion of oxygen, long nozzle life and/or easiest lance-nozzle renewal are the most immediate avenues to the greatest net gains from oxygen injection.

What NBD Is Doing To Insure Top Gains from O_2 Injection

NBD is carrying out the following programs for steel producers:

OXYGEN DISPERSION—On the basis of its studies on lance positioning and lance-nozzle designs, NBD is assisting producers on the determination of most efficient nozzle-port sizes, number of nozzle ports and reflective angles. NBD is also assisting with over-all features of the lance design.

LONGER NOZZLE LIFE—Within this area, NBD study has defined the eight prime causes of erratic nozzle behavior as: (1) manpower failure in lance handling, (2) cooling-water failure, (3) porosity in copper nozzle, (4) failure of welds between copper nozzle and steel-lance piping, (5) limitations of conventional nozzle design, (6) low thermal conductivity of nozzle, (7) oxidation (chamfering) of nozzle ports, and (8) thermal fatigue in nozzle.

The first two of these factors are a prime responsibility of the steel producer. But the next six fall largely within the province of the nozzle supplier. In view of this, NBD has approached nozzle problems from three directions—metallurgy, design and manufacturing—with these results:

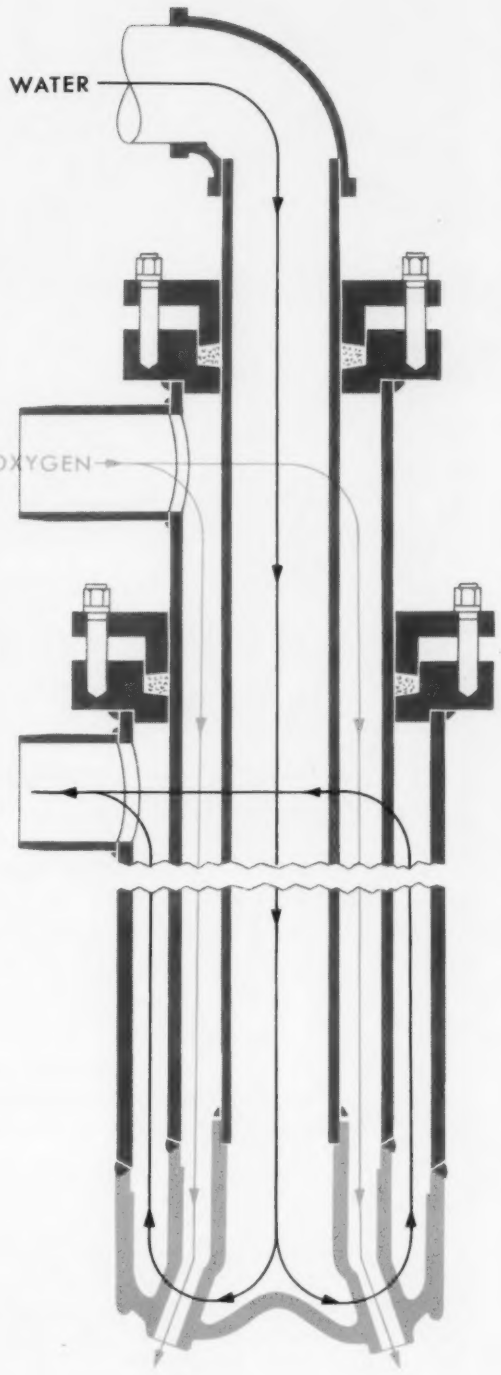
Metallurgy/Manufacturing—Exacting manufacturing controls, specifications and inspection procedures have been established. These assure sound, dense, pressure-tight nozzles of consistently high thermal conductivity. Also good weldability and properly oriented grain size for maximum resistance to thermal fatigue and chamfering.

Design Refinements—NBD design engineers have concentrated on problems of heat transfer, elimination of water and steam trapping and slag plugging of ports. As a result, NBD offers many nozzle and lance refinements. (See drawing at the right.) Among these refinements: internal cooling fins, drip shrouds, special chamfer-minimizing port designs, positive cooling channels.

EASIER LANCE RENEWAL—Welding of copper nozzles to steel lances can be troublesome, so NBD has provided facilities for welding of nozzles to desired lengths of steel lance. Carefully pressure tested and checked for tubing concentricity before shipment, these nozzle-lance assemblies speed renewal in open-hearth maintenance shops. When required, NBD also provides for ceramic coating of nozzles and lances.

If you are now considering conversion to O_2, or are seeking more efficient and economical results from existing installations, NBD is in a position to help.

Benefit from more than seven years' work with the O_2 process! Contact the National Bearing Division, 717-H Grant Bldg., Pittsburgh 19, Pa. Or consult your nearest NBD representative.



U. S. Patent 2,863,656

AMERICAN Brake Shoe COMPANY

NATIONAL BEARING DIVISION

717-H Grant Building • Pittsburgh 19, Pennsylvania

PARTIALLY-COMPLETED THERM-O-FLEX SHOWING GLASS FILTER TUBES INSTALLED

To Clean Electric Furnace Fumes To 550° F.

A MAJOR STEEL COMPANY

SELECTS **THERM-O-FLEX** GLASS FILTERS!

SELECTION MADE AFTER EXTENSIVE PILOT PLANT STUDIES PROVED "THERM-O-FLEX" ADVANTAGES

To insure clean gas emission from its large electric furnace operations, a major steel company has installed a Western Precipitation "Therm-O-Flex" Hi-Temperature Filter system *—the filter system featuring silicone-treated glass bags that efficiently clean gases as hot as 550° F!*

This is one of the first steel plant installations to use glass bag filters for cleaning electric furnace emissions, the installation being made only after an exhaustive pilot plant study. Subsequent operation of the full size installation has clearly substantiated the pilot plant results and has demonstrated the unusually high collection efficiency of "Therm-O-Flex" equipment on this type of application.

No Shaking Required

In addition to their ability to handle unusually hot gases, the specially-treated woven glass filters of the "Therm-O-Flex" permit the filter units to be easily cleaned by simply collapsing the bags. *No destructive shaking processes are required.*

Furthermore, the large diameter filter tubes (12″ in diameter) provide more efficient cleaning of the collected material on each collapsing cycle—another operating advantage engineered into each "Therm-O-Flex" installation by Western Precipitation dust control "know-how."

"Therm-O-Flex" is one of six types of gas cleaning equipment offered by Western Precipitation — *"Cottrell" Electrostatic Precipitators, "Multiclone" Centrifugal Collectors, "CMP" Combination Multiclone-Precipitator units, "Therm-O-Flex" Hi-Temp Filters, "Dualaire" Jet-Cleaned Filters, and "Turbulaire-Doyle" Scrubbers.* No other organization provides such wide range dust collection experience — no other offers such unbiased recommendations to fit the requirements of *your particular* operations. You simplify your gas-cleaning problems by bringing them to Western Precipitation.

Send for "Therm-O-Flex" Bulletin #F105R

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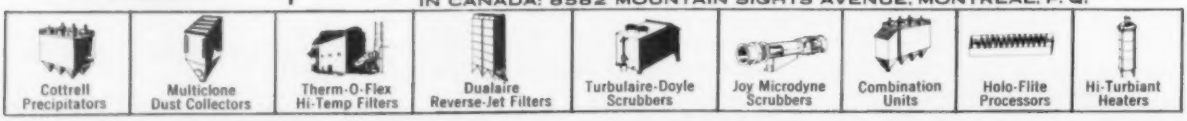

72 Years of Engineering Experience behind MORGAN ROLLING MILLS

Since 1888 the Morgan Construction Company has used engineering with ingenuity—employed top flight creative skills—to make many significant contributions in the field of rolling mill equipment. For example, Morgan has developed and produced:

Continuous Billet and Sheet Bar Mills—Continuous Skelp Mills—Continuous Mill Twist Guides—Automatic Rod Reels—Continuous Billet Heating Furnaces—Hydraulic Flying Shears—Steam Flying Shears—Up and Down Cut Flying Shears—DuoFinishing Mills—Escapement Type Cooling Beds—Universal Type Cooling Beds—Carryover Type Cooling Beds—Automatic Pack Annealing on Cooling Beds—Four Strand Rod Mills—Double Strand Merchant Mills—Skew Y Reversing Tables—Edging Mills—Vertical Mills—MORGOIL Bearings—Automatic Billet and Slab Separating Skids—Electric Crop and Cobble Shears.

. . . and many more contributions to come from the skilled, imaginative engineers of Morgan Construction Company.

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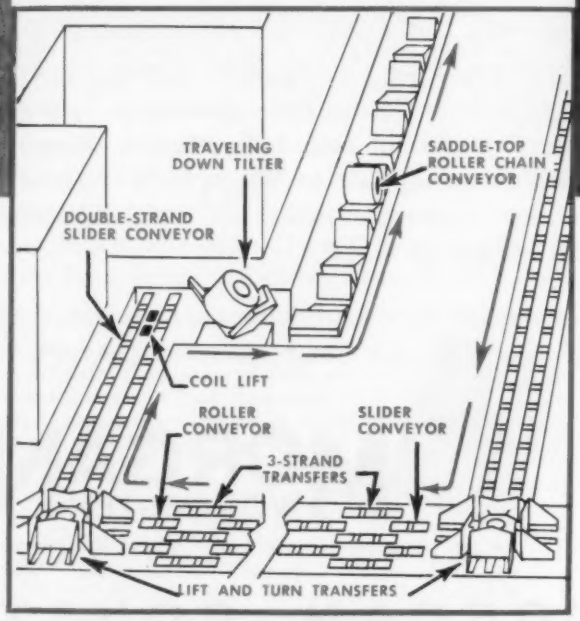

LINK-BELT coil conveyors take on a tough handling job for Inland Steel

Putting these heavyweights through the mill without damage calls for sure, delicate handling. It's a difficult job performed with precision and safety on Link-Belt conveyors. Coils weighing 15 tons each move automatically from coiler to pickling line.

All through industry, Link-Belt is advancing materials handling to match the pace of production technology. In steel mills throughout the country, Link-Belt conveyors, processing and power transmission machinery—plus expert engineering—are helping to cut costs and improve plant output. For complete details on single units or complete systems, contact your nearest Link-Belt office. Ask for Book 2764. 15,380

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Perfectly at home in the maze of girders and hangers that will soon support a giant boiler are these steel workers and boilermakers. Our experienced teams have proved repeatedly their ability to complete projects on schedule and within the budget. United Engineers has served many of the country's leading steel producers on projects of widest size and complexity—designing and installing rolling mills, coal-chemical facilities, power plants and other equipment. Each project demonstrates the time and cost-saving advantages in our coordination of design, purchasing, expediting and construction. We invite you to share and profit from our background of 75 years' experience as designers, construction engineers, and engineering consultants.

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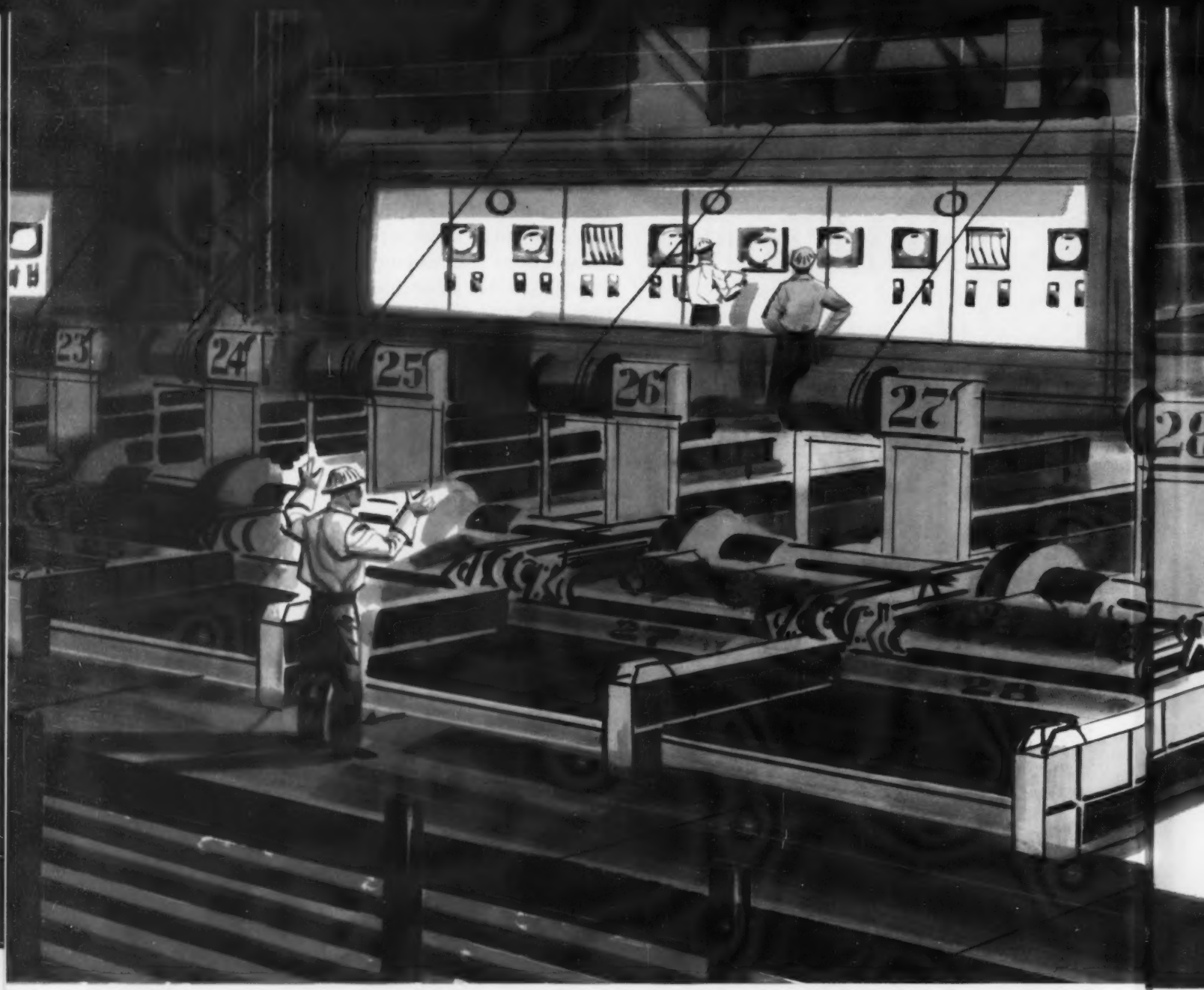

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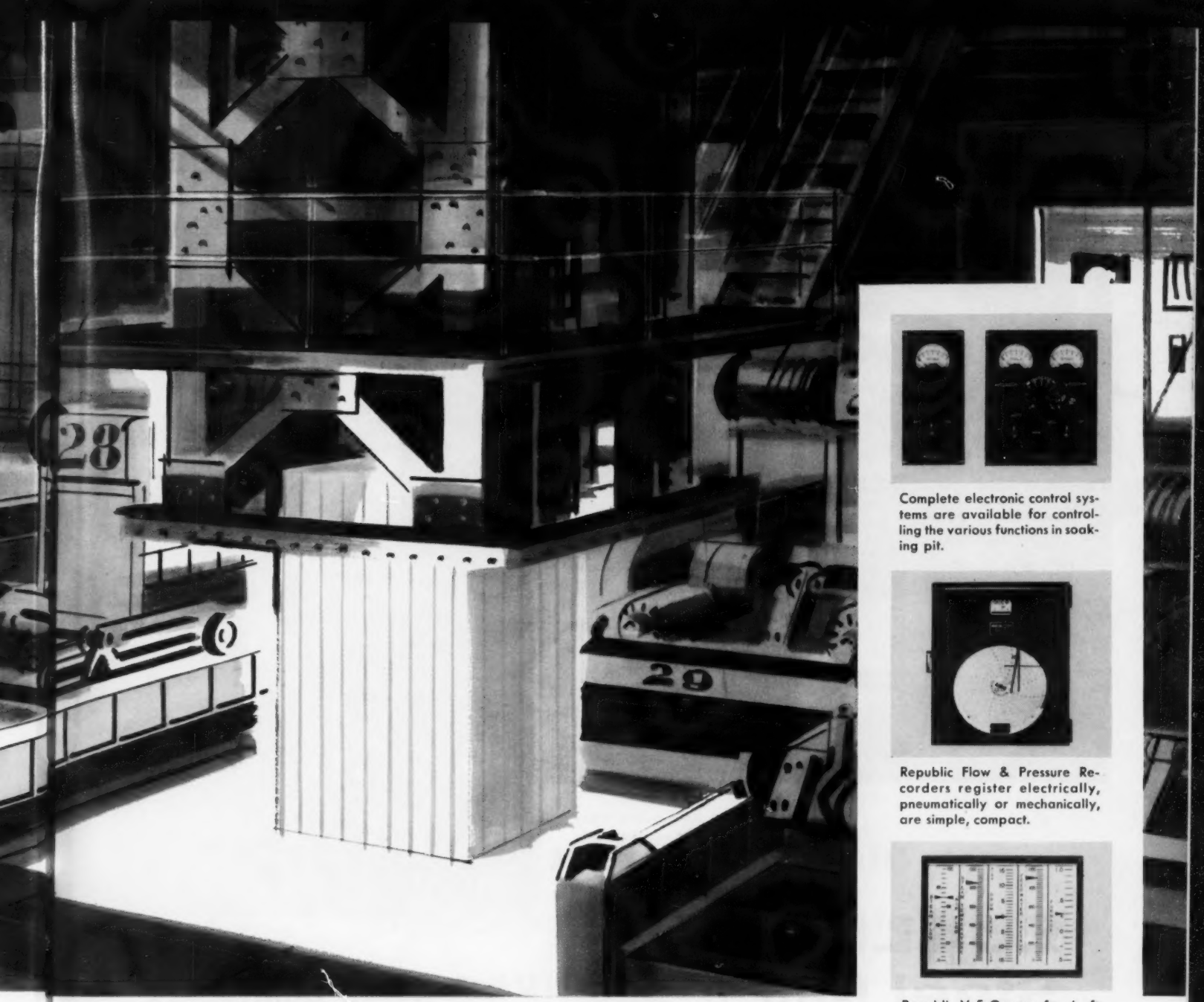
When you specify Republic Flow Meters engineering service in the designing, building and installing of electronic control systems for soaking pits, you benefit from the experience of a leading furnace control manufacturer. The complete line of Republic pneumatic and electronic equipment handles the metering, recording, indicating, and controlling of soaking pit operations for both recuperative and regenerative type furnaces. Republic controls are performing daily on soaking pit operations, handling the fuel-air ratio control, flue draft control, air and gas pressure control, air flow recording, etc.

When you install new soaking pits, or overhaul existing ones, check the important advantages you get from Republic Flow Meters Complete Control Engineering Service:



Complete electronic control systems are available for controlling the various functions in soaking pit.

Republic Flow & Pressure Recorders register electrically, pneumatically or mechanically, are simple, compact.

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Republic Final Drive Units operate valves, damper, inlet vanes, etc., in response to air loading pressures or electronic signals.

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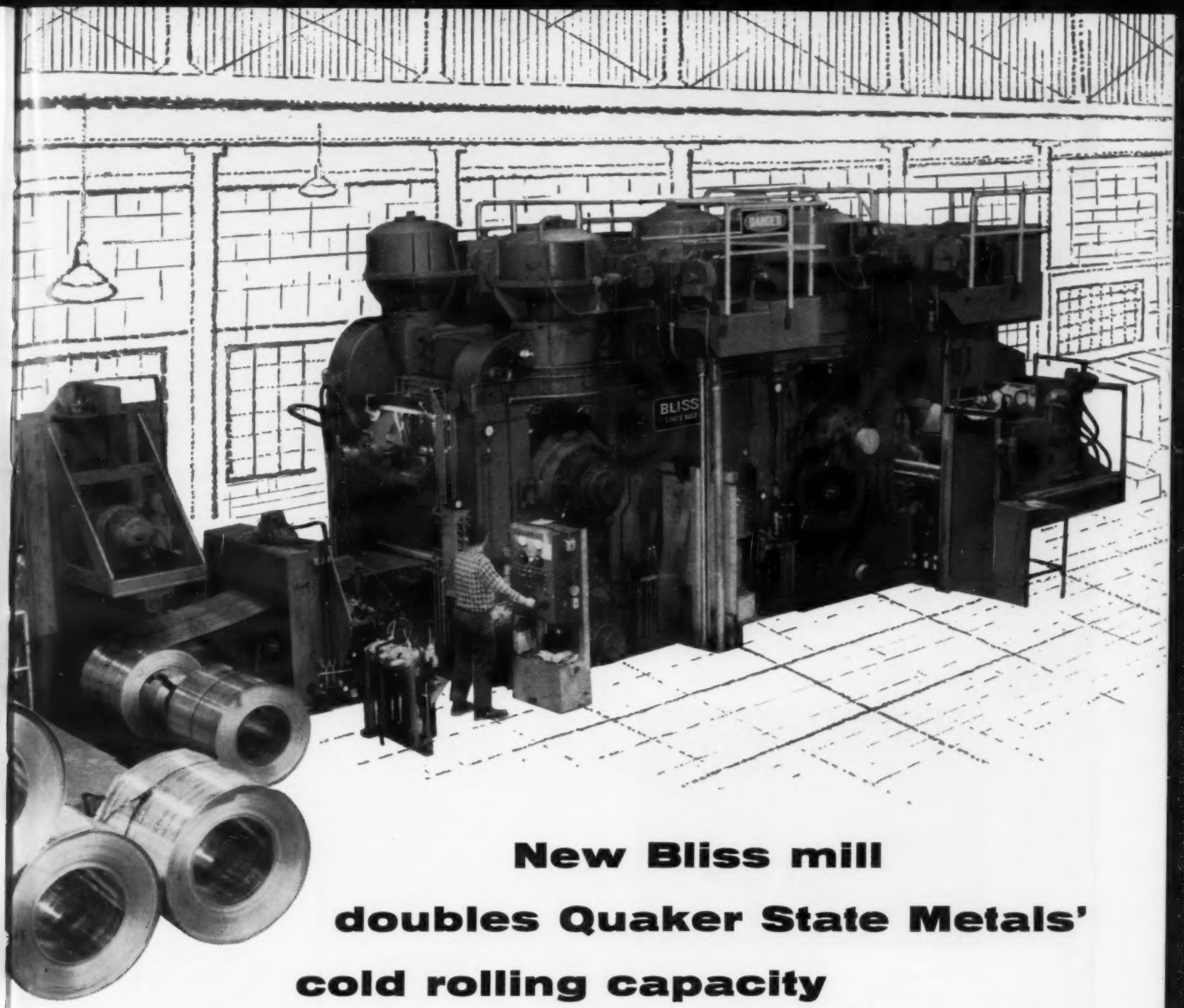

New Bliss mill doubles Quaker State Metals' cold rolling capacity

With a rolling capacity now approaching 10 million pounds a month, Quaker State Metals Company of Lancaster, Pa., division of Howe Sound Co., ranks as one of the largest independent rollers of aluminum in the United States.

A new Bliss tandem mill is a key unit in Quaker State's recently completed expansion program. In production a week after its erection was completed, the mill has more than doubled the plant's cold rolling capacity.

It reduces strip from .250 inch to .062 inch in a single pass. Delivery speed is 1500 fpm. Coil handling is completely mechanized, utilizing a coil opener equipped with a peeler knife and an automatic guide control.

Whether your own plans call for the addition or modernization of a single unit or a complete rolling plant, you'll find that the Bliss Rolling Mill Division can help you with the problems you may encounter. For examples of Bliss installations for rolling both ferrous and non-ferrous materials, write for our 84-page Bulletin 40-B.

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E. W. BLISS COMPANY, Rolling Mill Division, Salem, Ohio

Subsidiary: The Matteson Equipment Company, Inc., Poland, Ohio

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Handle Millions of Tons in Your Industry

MOTORIZED SHEET GRABS

INCREASE HANDLING EFFICIENCY

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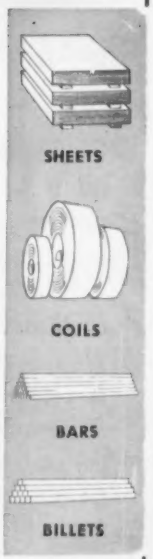
Whether *your* plant handles metal sheets, coils, palletized or skidloads, bars, billets, rods, tubes, boxes, barrels, or other materials, Mansaver can supply a manual, semi-automatic, fully-automatic, or power-operated Grab for your requirements.

Ask our District Representative into your plant to study your handling problem for personal recommendation or presentation for our solution.



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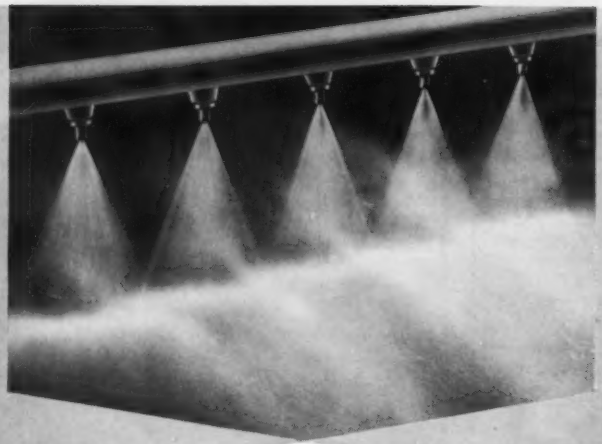

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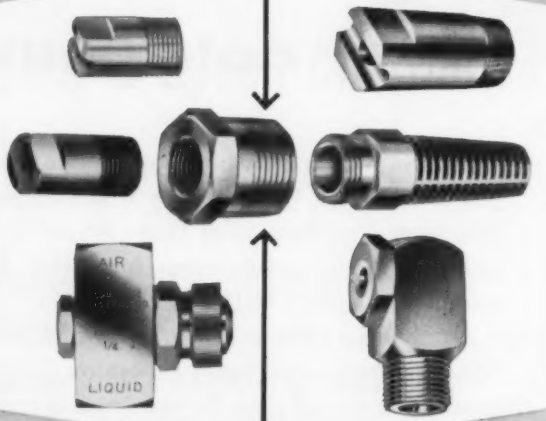

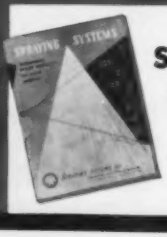

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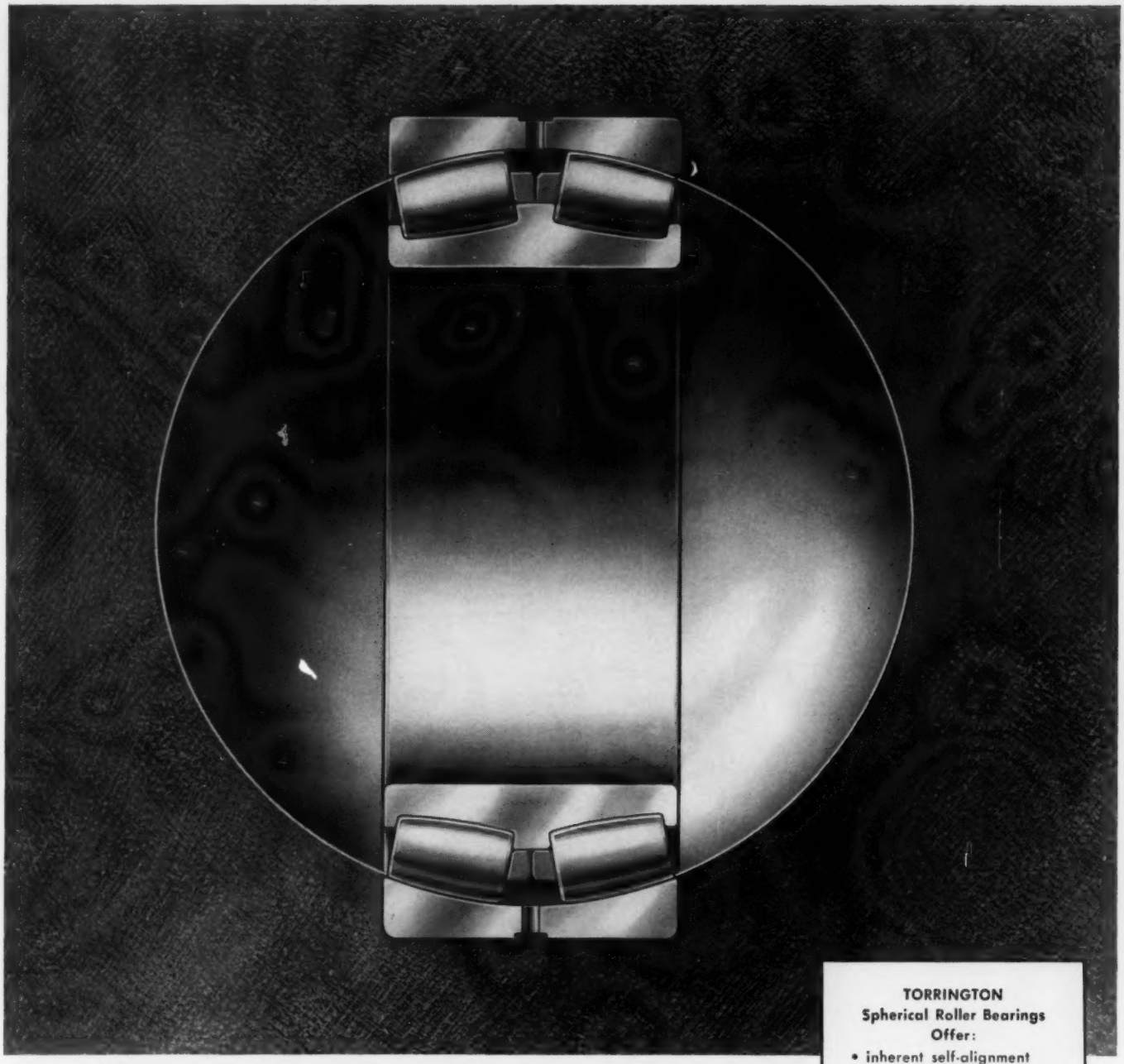


IN TORRINGTON SPHERICALS . . . NO COMPROMISE WITH QUALITY

The spherical design concept of Torrington Spherical Roller Bearings means superior performance and outstanding service life under the toughest operating conditions. It means inherent self-alignment, high radial and thrust load capacity, low friction. It allows compensation *within* the bearing for both dynamic and static misalignment.

Roller guidance is positive and accurate . . . is assured by grinding roller ends and center guide flange surfaces to a common spherical radius. Results are truer rolling motion, minimum friction and higher degree of geometric stability. Bearing operation is cooler, quieter, smoother.

If you're looking for outstanding bearing performance and bearing *value*, you should specify Torrington Spherical Roller Bearings. Backed by Torrington's uncompromising experience in engineering and manufacturing every basic type of anti-friction bearing, their quality is unmatched.

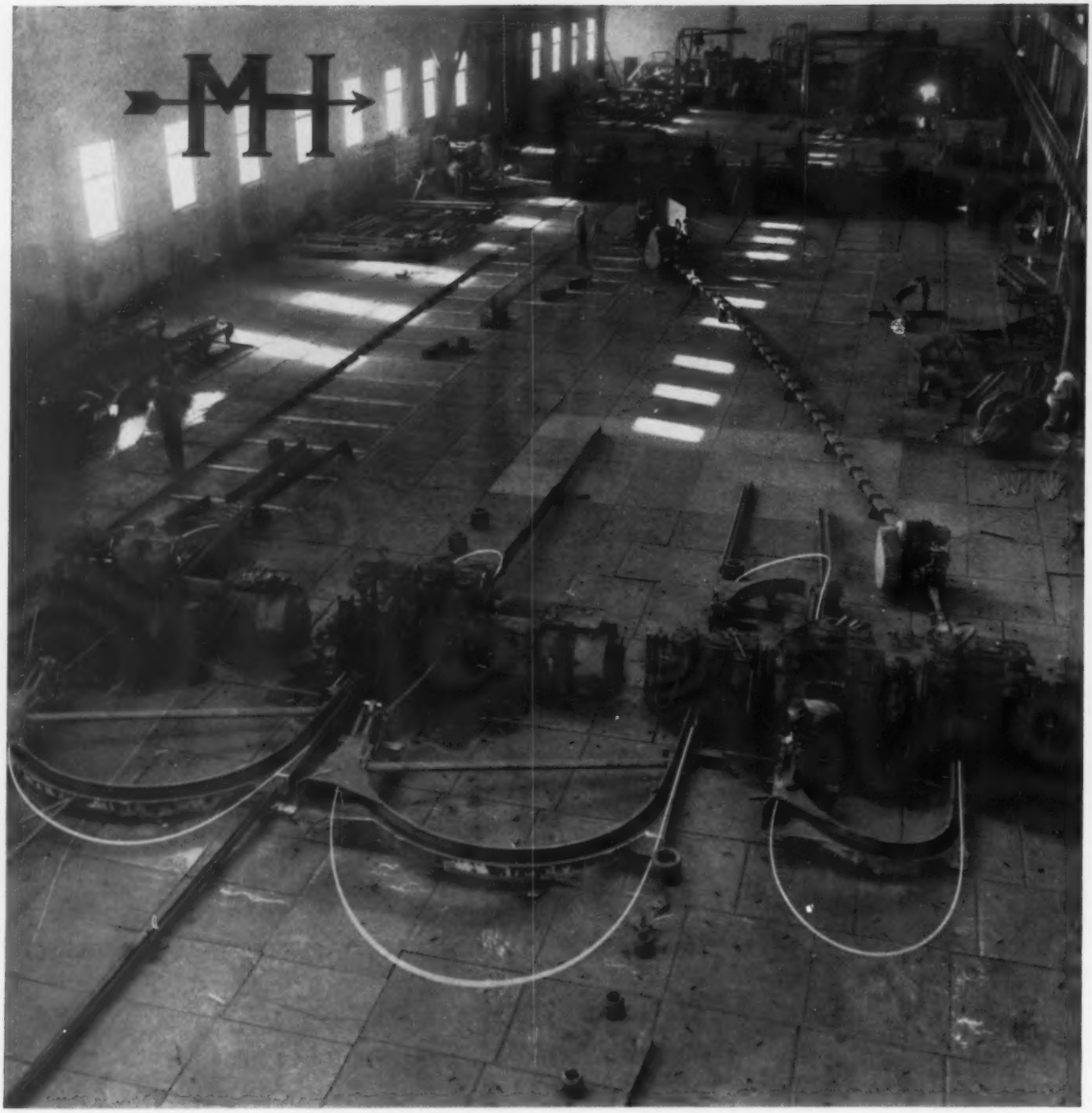
TORRINGTON
Spherical Roller Bearings
Offer:

- inherent self-alignment
- conformity of rollers to raceways
- integral center guide flange for stability
- positive roller guidance
- land-riding bronze cages
- maximum radial and thrust capacity
- controlled internal clearance
- electronically selected rollers
- even load distribution
- long, dependable service life

send for new Torrington Spherical Roller Bearing Catalog #258

progress through precision **TORRINGTON BEARINGS**

THE TORRINGTON COMPANY South Bend 21, Indiana • Torrington, Conn.



Combined Rolling Mill for medium and small sections and wire rod

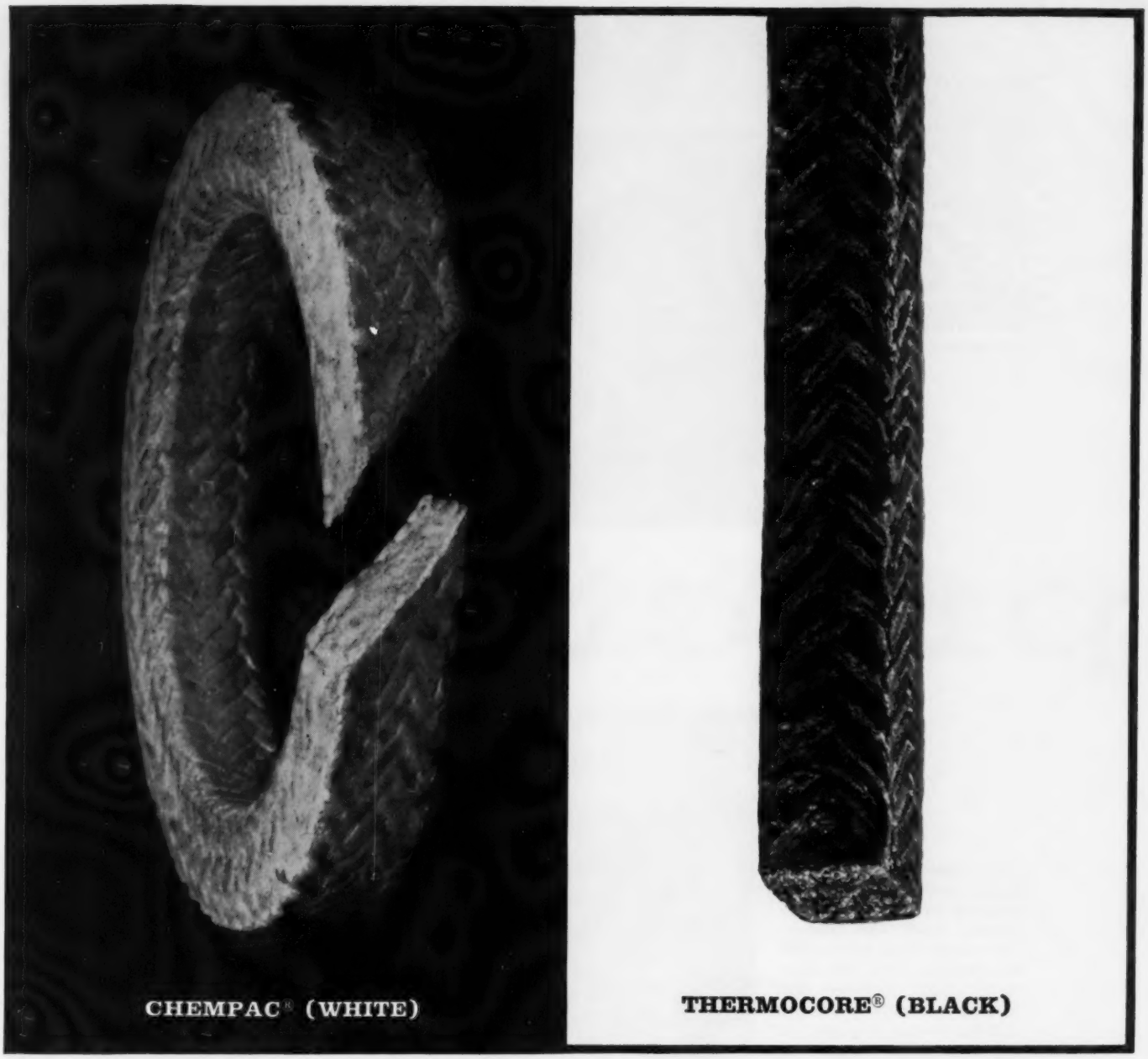
Morgårdshammar Combined Rolling Mills for high grade steels are designed to give closest possible tolerances and to allow the rolling of a large assortment of dimensions and sections, from 5 in. down to about 3/16 in. round.

For further information, please apply to us for reprints from the Journal of the Iron and Steel Institute.

Swedish Quality

MORGÅRDSHAMMAR

MORGÅRDSHAMMARS MEK. VERKSTADS AB • MORGÅRDSHAMMAR



Now—just two J-M styles will handle 9 out of 10 mechanical packing problems!

LET VERSATILE "BLACK" OR "WHITE" HELP YOU REDUCE PACKINGS INVENTORY

Of Johns-Manville's many packing styles, two stand out as "all-purpose" packings. One is for pumps, the other for valves. These two packings not only do an outstanding sealing job . . . they also simplify your packings inventory investment to a minimum.

In 9 out of 10 cases, CHEMPAC and THERMOCORE will handle any pump or valve job in your plant!

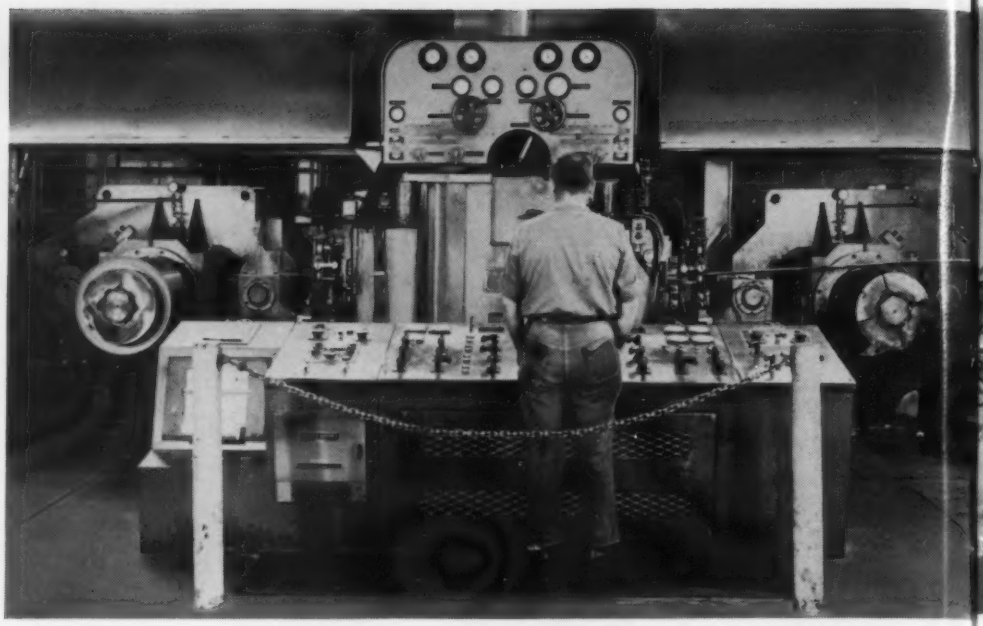
CHEMPAC (white) combines the excellent sealing and heat-resistant qualities of asbestos . . . with Teflon's immunity to almost all chemical and solvent action. Chempac Style 2009 will give outstanding service on pumps, expansion joints and agitators.

THERMOCORE (black) consists of asbestos yarns, reinforced with Inconel wire . . . braided over a plastic core of graphite and 100% white asbestos. It remains stable even in valves where line temperatures run as high as 1200 F . . . adapts readily to eccentric motion. Thermocore Style 397 is recommended as the "universal" valve packing.

Johns-Manville produces the industry's most complete range of packing styles. These are described in a new 64-page Mechanical Packings book—the most complete of its kind. In its handy pages, you will find answers to the correct selection of packings best suited to each particular requirement.

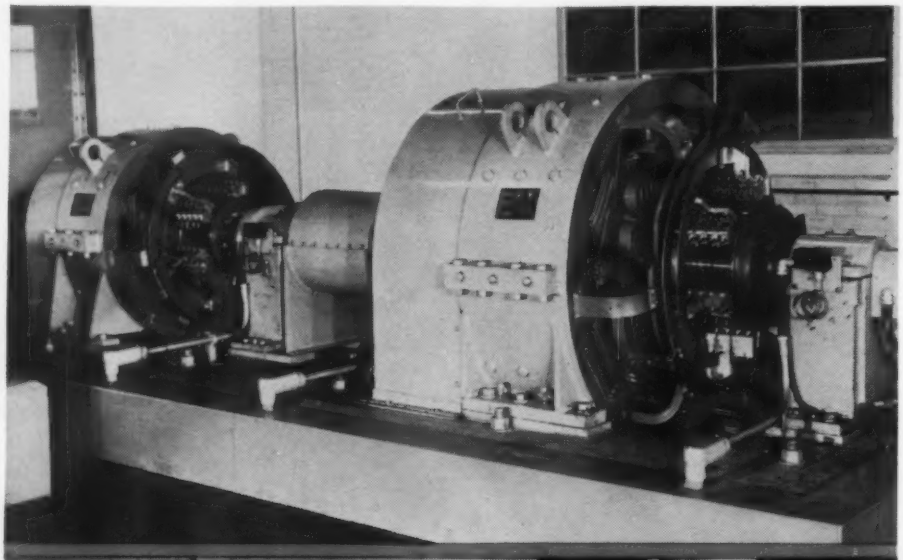
For full information on "WHITE" and "BLACK," see your J-M Distributor . . . or write to Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ont.

JOHNS-MANVILLE JM PRODUCTS



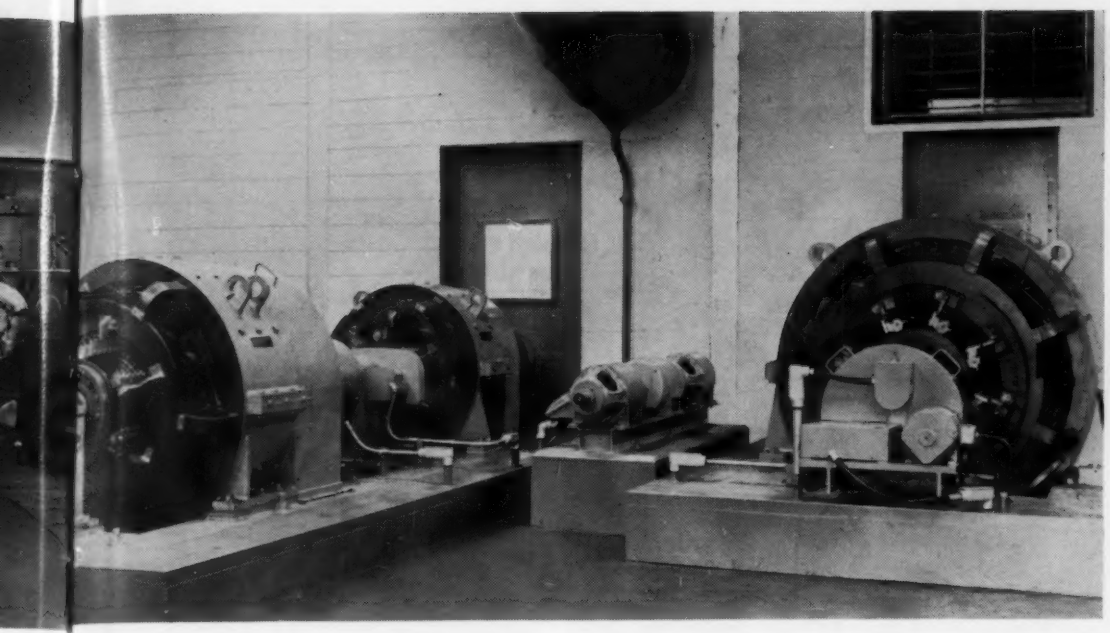
Operator faces control panel of the 26-in. reversing cold strip Sendzimir Mill. Specially designed to roll both high- and low-carbon strip steel to close tolerances, this mill features X-ray gages with automatic control and recording units which assure uniform high quality and extreme accuracy. Elliott engineered the complete automatically-controlled, self-correcting drive.

precision·



Close speed regulation and ample power at all loads is assured by the Elliott-engineered drive. The tandem unit shown here powers the left winding reel. The magnetic clutch between the 300-hp motor (left) and the 600-hp motor engages or disengages the larger motor, as required.

The Elliott adjustable-voltage system provides continuous speed adjustment for both the work rolls and the winding reels, from low threading speed up to 1500 fpm. Adjustable voltage is supplied by the four-unit Elliott motor-generator set seen here. Left to right, 1500-kw generator, 3000-hp synchronous motor, and twin 750-kw generators. All main drive machines are built with enclosures for updraft forced ventilation.



At the left is seen one of the winding reel tandem drives which enables the mill to handle a broad range of products. It consists of 600- and 300-hp motors operating at 400/1200 rpm, connected by a magnetic clutch. The main driven rolls are powered by the 1750-hp, 450/850 rpm Elliott Motor at the right.

controlled

The Stanley Works' new Sendzimir Mill at New Britain, Connecticut produces high- and low-carbon strip steel to meet the broadest range of dimensional specifications. Automatic speed synchronization of mill and reels provides strip uniformity and increased yield. Elliott engineered and furnished the complete "tailor-made" drive.

HOW ELLIOTT INDUSTRY ENGINEERING SERVES STEEL AND NON-FERROUS INDUSTRIES

Elliott has engineered complete mill drives and coordinated all associated equipment for virtually every type of mill for leading producers and fabricators.

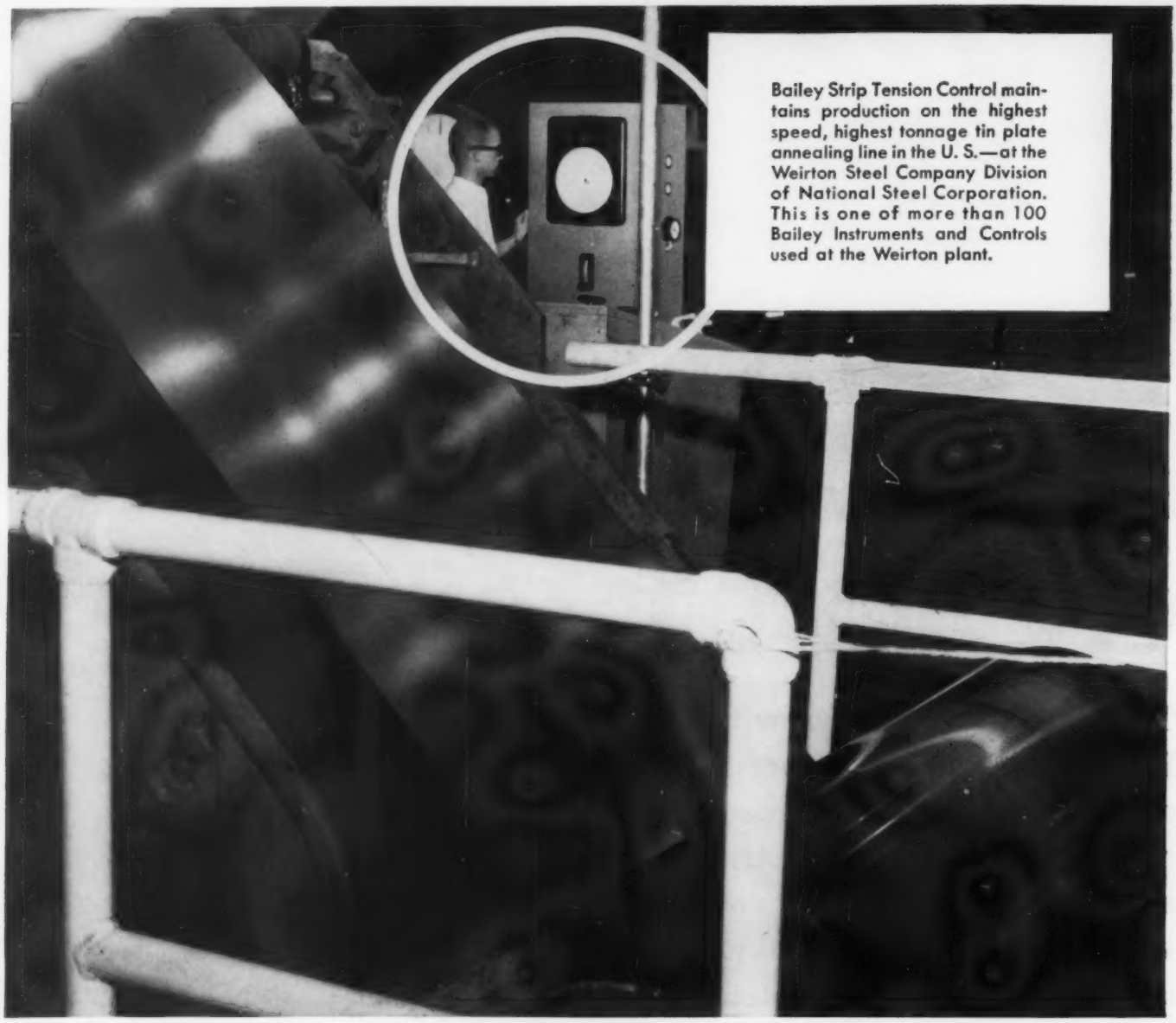
Bulletin Q-23A describes the wide variety of Elliott experience in mill electrification.

Elliott's versatile, experienced Industry Engineering staff can help you increase production and cut costs.

ELLIOTT Company

RIDGWAY PLANT RIDGWAY, PA.

R10-1



Bailey Strip Tension Control maintains production on the highest speed, highest tonnage tin plate annealing line in the U. S.—at the Weirton Steel Company Division of National Steel Corporation. This is one of more than 100 Bailey Instruments and Controls used at the Weirton plant.

Strip keeps rolling when Bailey keeps an eye on it

Installing Bailey Strip Tension Control will cost you far less than a single strip breakage in a furnace due to poor tension control . . . and it's the surest way of ending tension problems.

Strip tension at speeds up to 2000 feet per minute is pre-set, controlled, and recorded by this unique system. Bailey S.T.C. eliminates undue instantaneous strains through natural 'cushioning' of pneumatic control. It helps maintain strip flatness during finishing operation by minimizing slack formations, and it simplifies strip tracking by holding tension within allowable limits.

If you roll strip, see your Bailey Engineer about Strip Tension Control, or write the Iron and Steel Division for more information.

S114-1

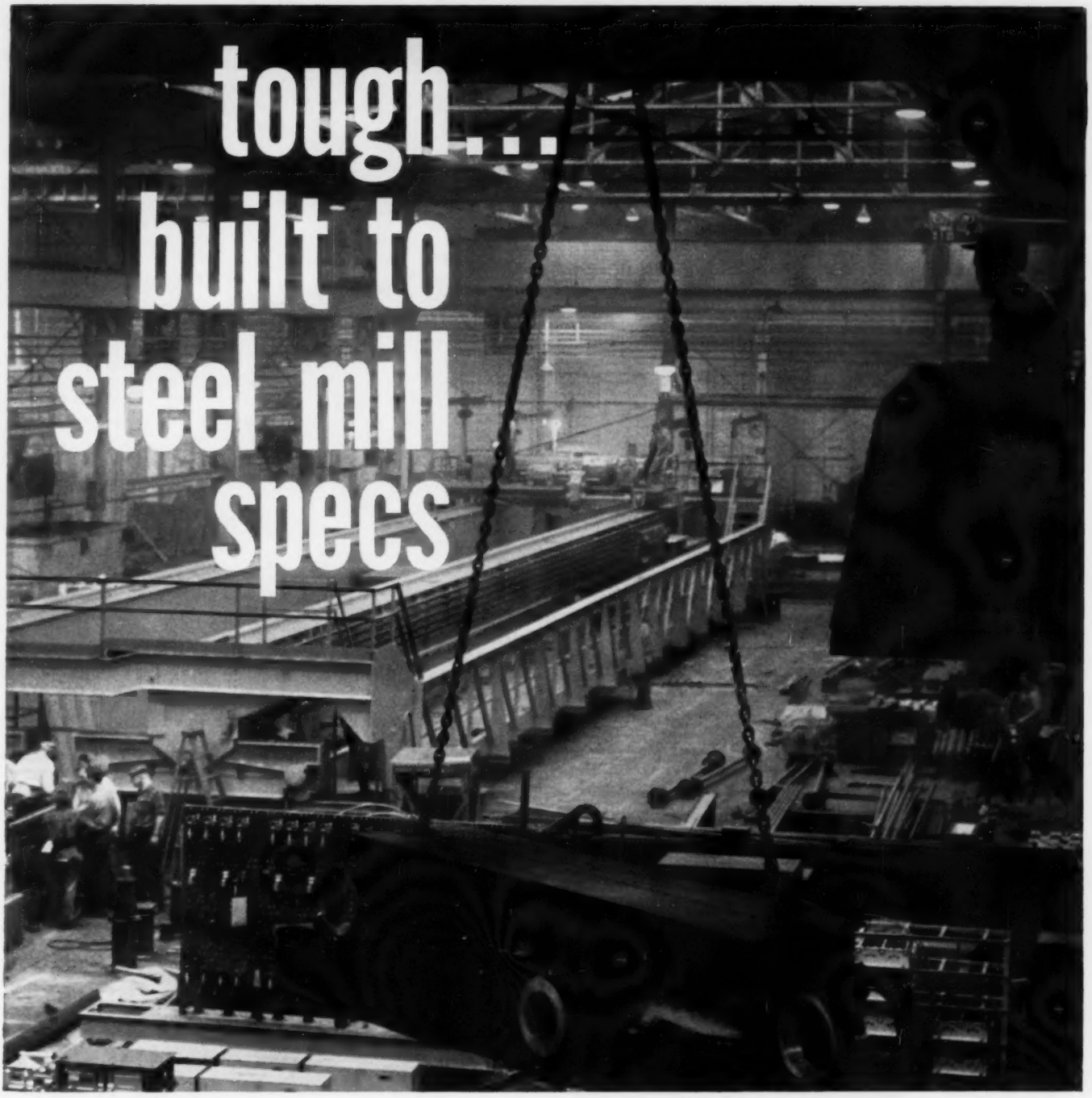
IRON AND STEEL DIVISION

BAILEY METER COMPANY

1047 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS



This tough 30-ton Whiting Tiger Crane with a 125′ span is thoroughly checked out on the assembly floor . . . then it's off to rugged, round-the-clock steel mill service. Whiting cranes for mill service easily meet the highest set of standards in all industry, A.I.S.E. specs, or are built to exacting customer requirements. And important Whiting extras like oil bath lubrication, herringbone gears, and long life antifriction bearings assure added years of efficient, dependable maintenance-free operation.

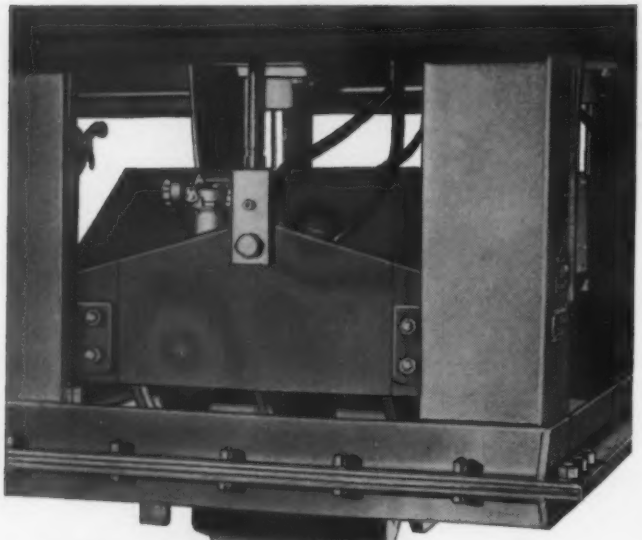
Whiting is your answer to every overhead handling problem. Write for the facts on "Whiting-Engineered Cranes," bulletin 80. *Whiting Corporation, 15655 Lathrop Avenue, Harvey, Illinois.*

COST-SAVING EQUIPMENT . . . THE WAY TO HIGHER PROFITS

CRANES

WHITING

MANUFACTURERS OF CRANES: TRAMBEAM HANDLING SYSTEMS: TRACKMOBILES: FOUNDRY, RAILROAD, AND SWENSON CHEMICAL EQUIPMENT

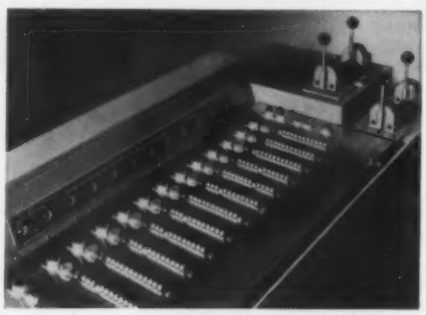


WORLD'S
MOST ADVANCED

Slab AND Bloom Marker

Characters are changed in the marking head and the stamping cycle is actuated from a remotely-positioned operator's console. Among refinements introduced in this latest GY-46 Series: raising and lowering of marking head can clear for 24" bloom . . . keystrips for automatic setup of characters . . . provision for use of printed tapes . . . automatic oiling system . . . provision for setting up by IBM or other punch card system.

On the operator's console a 12-position keystrip may be provided for each of the 12 wheels in the marking head. A press of a button moves any wheel to desired position.



Get comprehensive details in new 4-page Bulletin #613-D-Rev.

Mecco SAFETY Model 701-RCW
SLAB MARKER

A Product of the Marking Device Industry

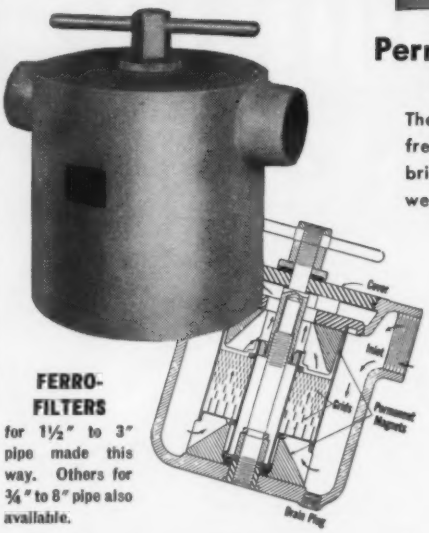
M. E. CUNNINGHAM CO.

1041 CHATEAU STREET, PITTSBURGH 33, PA.

Reduce Maintenance and Downtime of Mill Equipment . . .

with

FERROFILTER®



FERRO-FILTERS for 1½" to 3" pipe made this way. Others for ¾" to 8" pipe also available.

Permanent Magnet Separators

They keep lubricating oil lines free from ferrous grit that bridges the oil film to cause wear on bearings, gears and other moving parts.

FERROFILTERS help cut the cost of maintenance, downtime and replacement of equipment to the minimum.

Write for Bulletin

S. G. Frantz Co., Inc.

446 Kline Ave. at Brunswick Pike.
P. O. Box 1138 Trenton 6, N. J.

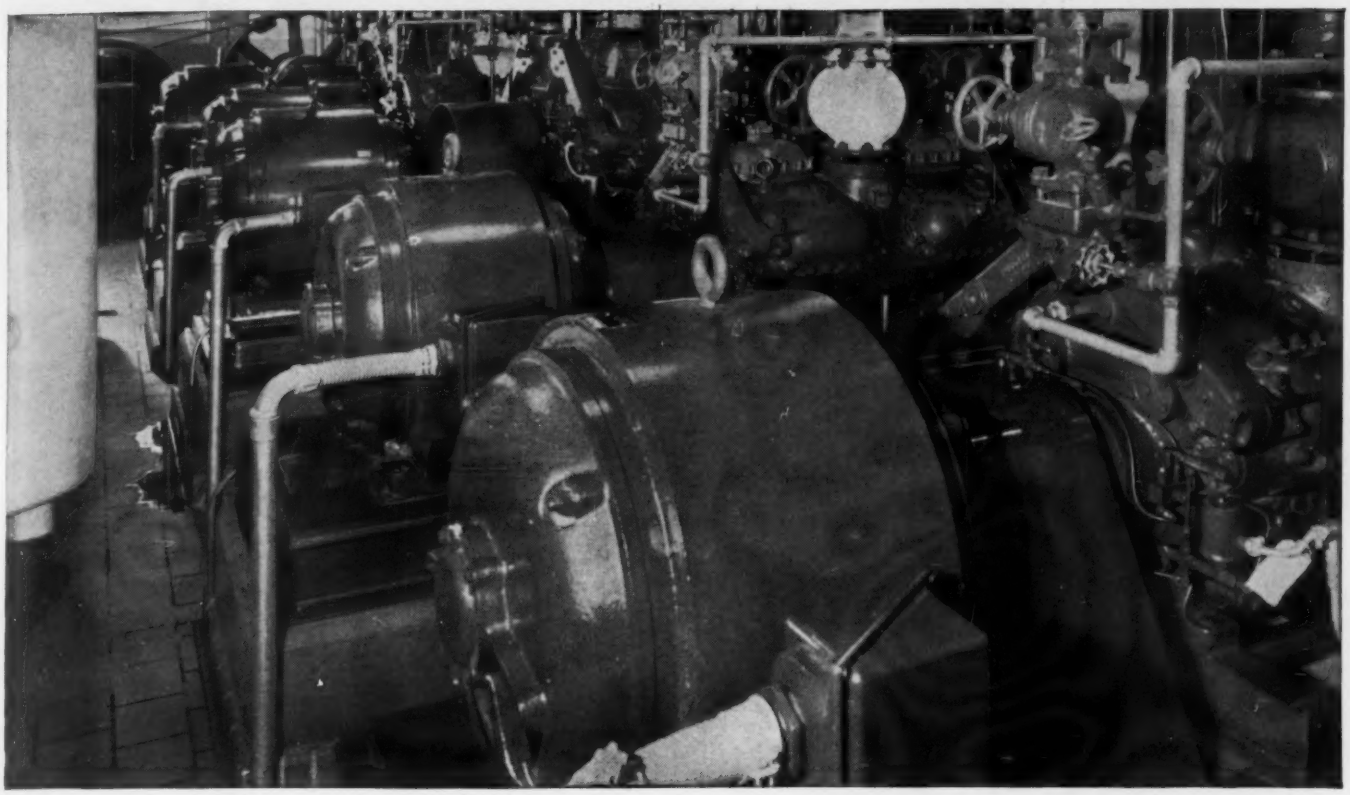
"CLEVELAND"
Billet & Structural
SHEAR BLADES

Forty years of experience plus the HILL ACME guarantee of material and workmanship are your assurance of complete reliability and "know how" in producing CLEVELAND Alloy Grade billet and structural shear blades for shearing hot and cold metals.

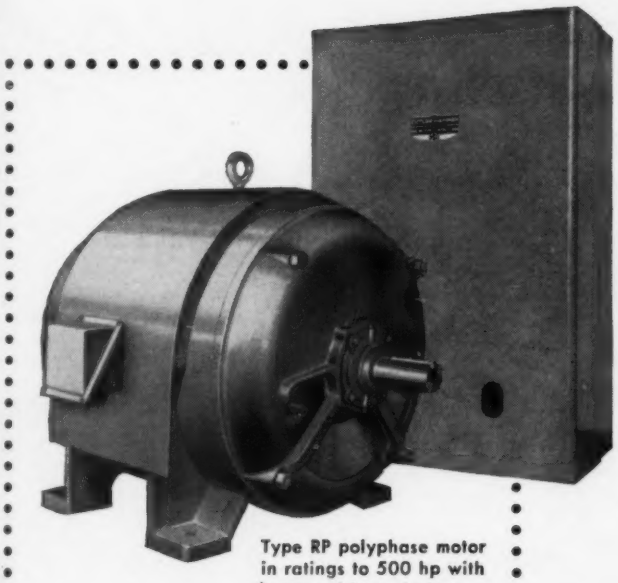
We are the *only* manufacturers of both shears and shear blade for this application. The advantages of using CLEVELAND blades, produced by a shear manufacturer, are obvious.

THE HILL ACME COMPANY
CLEVELAND KNIFE DIVISION
1203 West 65th Street • Cleveland 2, Ohio

WAGNER ELECTRIC MOTORS . . . THE CHOICE OF LEADERS IN INDUSTRY



End Voltage Drop and Line Disturbance Problems caused by starting ***BIG MOTORS . . .***



Type RP polyphase motor in ratings to 500 hp with increment type starter.

Use Wagner Increment Motor-Starter Combinations

Increment starting is the easy, inexpensive way to limit the inrush of starting current in motors up to 500 horsepower. And, you do it *best* with Wagner Increment Motor-Starter Combinations . . . matched polyphase motors and magnetic increment starters.

They do the job efficiently by reducing current drawn from the line on each point of the starter. Line disturbances are reduced because current taken from the line is not broken during the starting period. Motors start sure and fast . . . reach full speed in a matter of seconds. They do the job economically, too, because Wagner combinations cost less than motors with primary resistance or auto-transformer type starters. Two more plusses: The compact, relatively lightweight starter is easy to connect, and maintenance is minimized. The motor requires only regular inspection, cleaning, and lubrication . . . the starter needs very little attention.

Wagner two-step motor and starter combinations are suitable for most applications. For installations where unusually low inrush of starting current is required, 3, 4, 5, or 6-step increment motor-starter combinations are available. All combinations fully meet the polyphase motor starting requirements of AEIC-EEI-NEMA. Their dependability and efficiency—their ability to get the job done—has been proved by more than 20 years of service in the field.

Why don't you investigate Wagner Increment Motor-Starter Combinations? It's possible they can save you money on your big jobs. Your Wagner Sales Engineer will help you select the combination that meets your requirements. Call him now, at the Wagner branch nearest you, or write us for Bulletins MU-128 and MU-195.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation

6483 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

WM60-1

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

RUST-OLEUM®

NEW COLOR

HORIZONS System

STOPS RUST AND PROVIDES LASTING BEAUTY

Gone are the days when color was used for the sake of color alone. Today, color is functional—helping to improve morale and increase efficiency—serving to color-code and mark safety areas, etc. The Rust-Oleum New Color Horizons System goes even further. It combines four important factors (1) the ability to stop rust, (2) smart, modern color harmony, (3) the durability to last and last, (4) ease of application that saves time, money, and metal. See how this system can bring lasting beauty to your plant, machinery, equipment, tanks, fences, etc. Your Rust-Oleum Industrial Distributor, with your Rust-Oleum Factory Specialist, will be happy to survey your plant and provide complete recommendations. Prompt delivery is assured from Industrial Distributor stocks in all principal cities of the U.S., Canada, and many countries around the world.

Faced with coating problems like these? Heat resistance, water resistance, chemical resistance, floors, galvanized metal, coatings that will dry in less than thirty minutes? Rust-Oleum, in its various systems, can be your answer. Call your Rust-Oleum Industrial Distributor, or write for the facts.

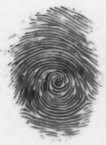
Apply Rust-Oleum 769 Damp-Proof Red Primer directly over sound, rusted surfaces to STOP RUST and cut maintenance costs

Just scrape and wirebrush to remove rust scale and loose rust—then brush Rust-Oleum 769 Damp-Proof Red Primer right over the remaining rust. Its **specially-processed** fish oil vehicle penetrates rust to bare metal as proved in radioactive tracing studies. You save time and money, as costly surface preparations are usually reduced.

RUST-OLEUM®

See our catalog in Sweet's.

STOPS RUST!®



Distinctive as your own fingerprint.
There are imitations,
but only **one** Rust-Oleum.
Accept no substitute.

PROVED THROUGHOUT INDUSTRY FOR OVER THIRTY-FIVE YEARS

You take the brush! Try a free test sample!

ATTACH TO YOUR LETTERHEAD

RUST-OLEUM CORPORATION
2984 Oakton Street • Evanston, Illinois

At no cost or obligation, please send me:

- ☐ New full-color catalog on New Color Horizons System and specialized Rust-Oleum systems, including color charts and applications.
- ☐ FREE TEST SAMPLE of Rust-Oleum 769 Damp-Proof Red Primer.
- ☐ Please have your representative contact us to discuss a plant survey.

NO PLACE TO GAMBLE...

TAPECOAT®
is Your Best Bet
to Protect Mill Lines
in Underground Service

Joints on this water line at steel plant are **TAPECOATED** to provide protection equivalent to coating on the pipe.

You take no chances when you specify TAPECOAT coal tar coating in handy tape form for pipe, pipe joints, fittings, couplings, tanks, tie rods and conduit on new construction, as illustrated, or for preventive maintenance on replacements.

Since 1941, TAPECOAT has proved its superiority in resisting moisture, acids, alkalis, chemical fumes and other severe corrosive and abrasive conditions.

For example, failure of a water line at an eastern steel plant in 1946 prompted this producer to turn to TAPECOAT for protecting the new line. Results were so conclusive that they have since standardized on TAPECOAT for wrapping fire prevention, water, gas and fuel lines in sizes ranging from 2″ to 48″.

TAPECOAT comes in rolls of 2″, 3″, 4″, 6″, 18″ and 24″ widths. It is easy to apply with the use of a torch. No skilled help required.

A TAPECOAT sales and service engineer is always available to help you on any corrosion problem. Write for details today.

The TAPECOAT® *Company*

ORIGINATORS OF COAL TAR COATING IN TAPE FORM

1541 Lyons Street, Evanston, Illinois

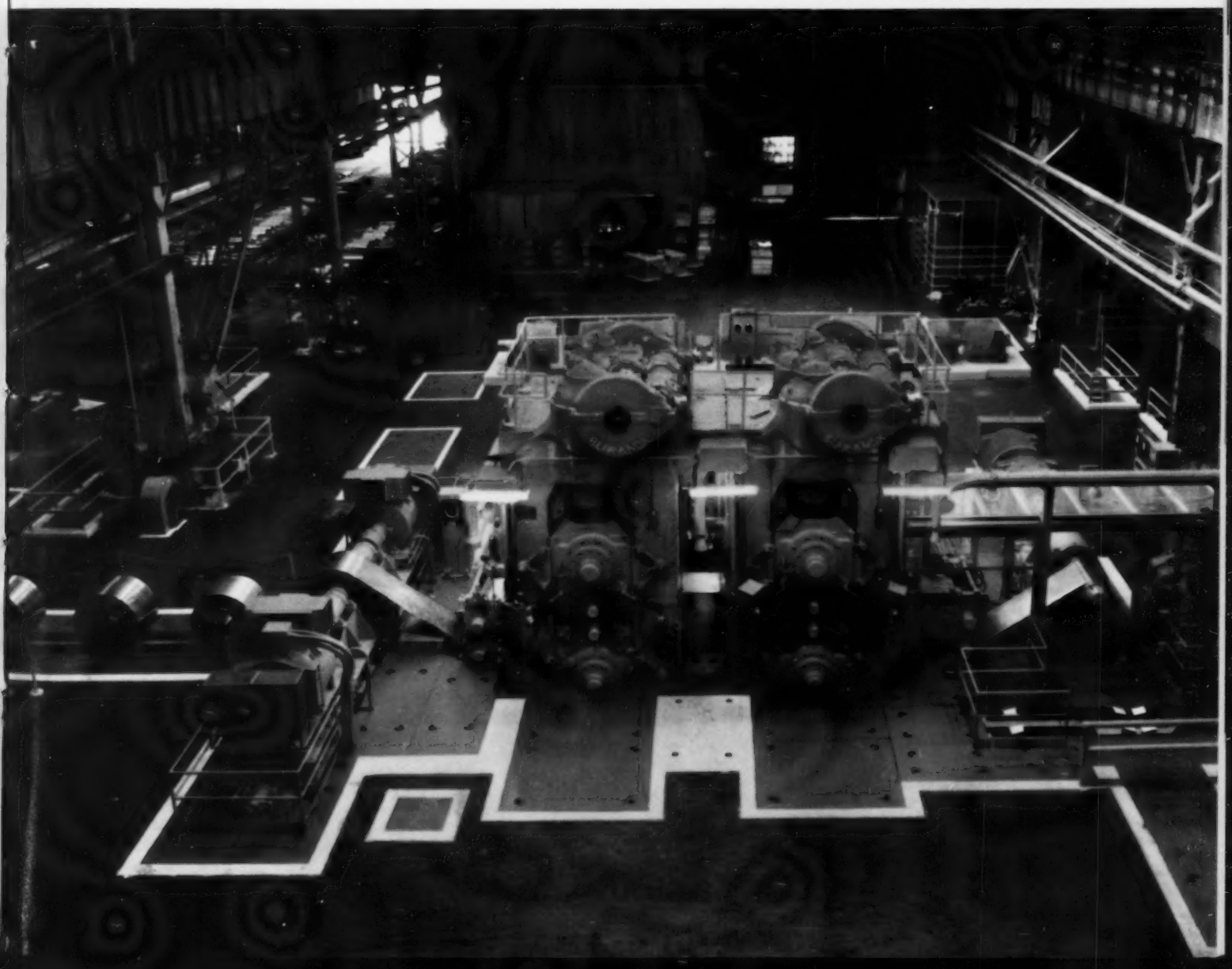
Representatives in Principal Cities

Manufactured and distributed in Canada by The Tapecoat Company of Canada, Ltd., 25 Haas Road, Rexdale, Ontario

BLAW-KNOX

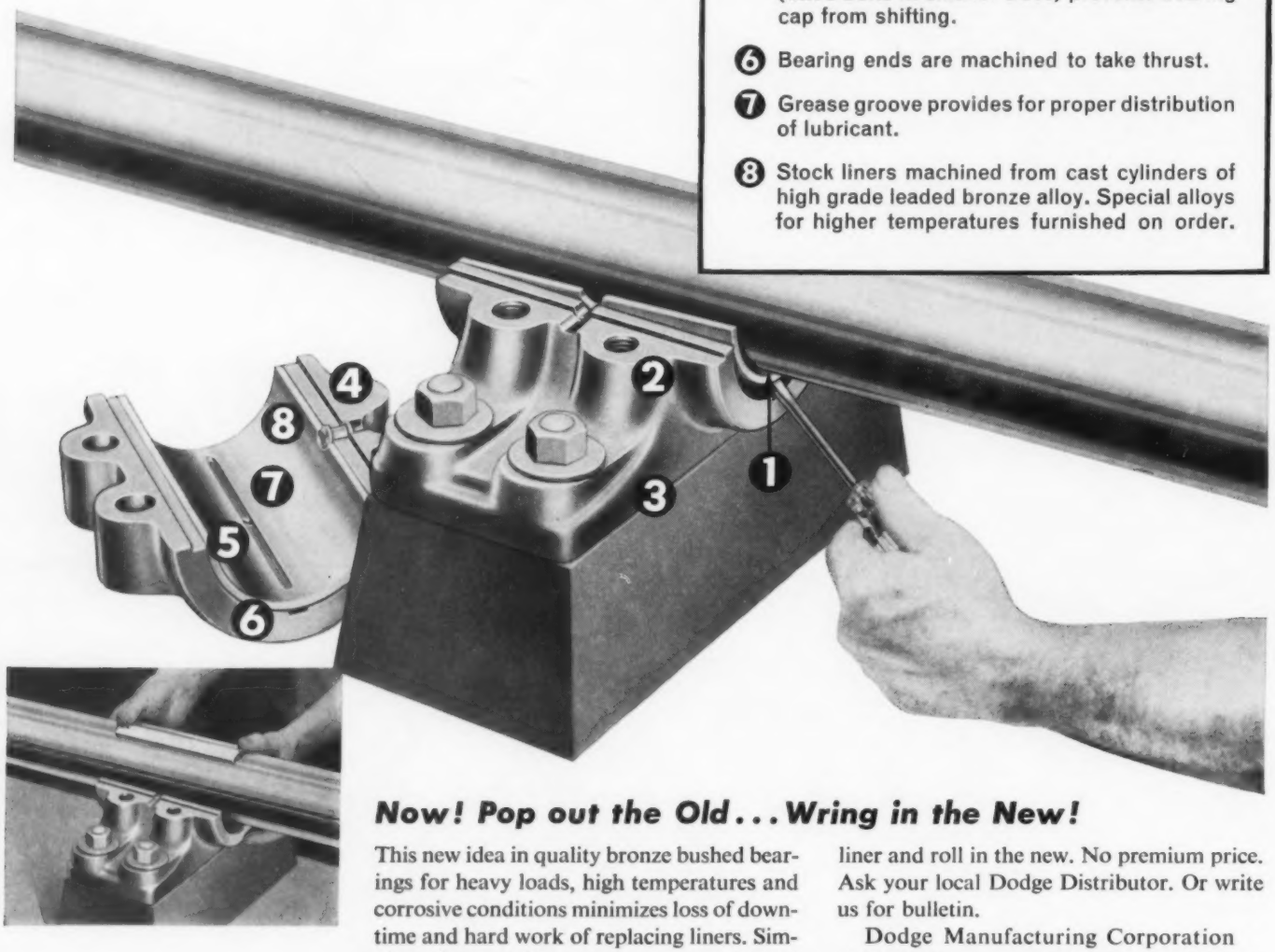
Blaw-Knox designs and builds a full range of two high and four high Temper Mills for integration into sheet, strip, and tin plate processing operations. Blaw-Knox equipment for the metals industry includes complete rolling mill installations and auxiliary equipment for ferrous and non-ferrous metals, sheet and strip processing equipment, electrolytic tinning, annealing, and galvanizing lines, seamless pipe and tube mills, draw benches, and cold draw equipment, Blaw-Knox Medart cold finishing equipment, iron, alloy iron and steel rolls, carbon and alloy steel castings, fabricated steel plate or cast-weld design weldments, steel plant equipment, and heat and corrosion resisting alloy castings. Blaw-Knox Company, Foundry and Mill Machinery Division, Blaw-Knox Bldg., 300 Sixth Ave., Pittsburgh 22, Pa.

19- and 53-inch x 48-inch high speed 2-stand Temper Mill.



ANNOUNCING A NEW IDEA IN BRONZE BUSHED BEARINGS ...A PRECISION LINER THAT IS REPLACEABLE ON THE JOB!

1. Precision bronze liner, replaceable without removing shaft or bearing base.
2. Rugged semisteel housing to withstand heavy shock loads. (Ductile iron or steel to order.)
3. Bottom of base machined for perfect alignment; close tolerance held to center of bore.
4. Brass spool locks both halves of bronze liner —prevents lateral movement and rotation. No pins, no screws. (Patent applied for.)
5. Tongue-and-groove joint in 4-bolt base sizes (fitted bolts in smaller sizes) prevents bearing cap from shifting.
6. Bearing ends are machined to take thrust.
7. Grease groove provides for proper distribution of lubricant.
8. Stock liners machined from cast cylinders of high grade leaded bronze alloy. Special alloys for higher temperatures furnished on order.

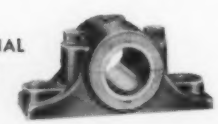


Now! Pop out the Old...Wring in the New!

This new idea in quality bronze bushed bearings for heavy loads, high temperatures and corrosive conditions minimizes loss of downtime and hard work of replacing liners. Simply relieve shaft pressure, remove the old liner and roll in the new. No premium price. Ask your local Dodge Distributor. Or write us for bulletin.

Dodge Manufacturing Corporation
5900 Union Street, Mishawaka, Indiana

SPLIT BRONZE BUSHED JOURNAL BEARINGS — 1 15/16" to 2 15/16"



RIGID BRONZE BUSHED PILLOW BLOCKS — 3 7/16" to 8"

ANGLE BRONZE BUSHED PILLOW BLOCKS — 1 15/16" to 8"

DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER — your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the *white* pages of your telephone directory, or in the yellow pages under "Power Transmission Machinery."

ALLIS-CHALMERS

Allis-Chalmers equipment for progressive mills: 1. motor, 2. control, 3. mercury-arc and semi-conductor rectifiers, 4. furnace transformers.

The right start for better end results

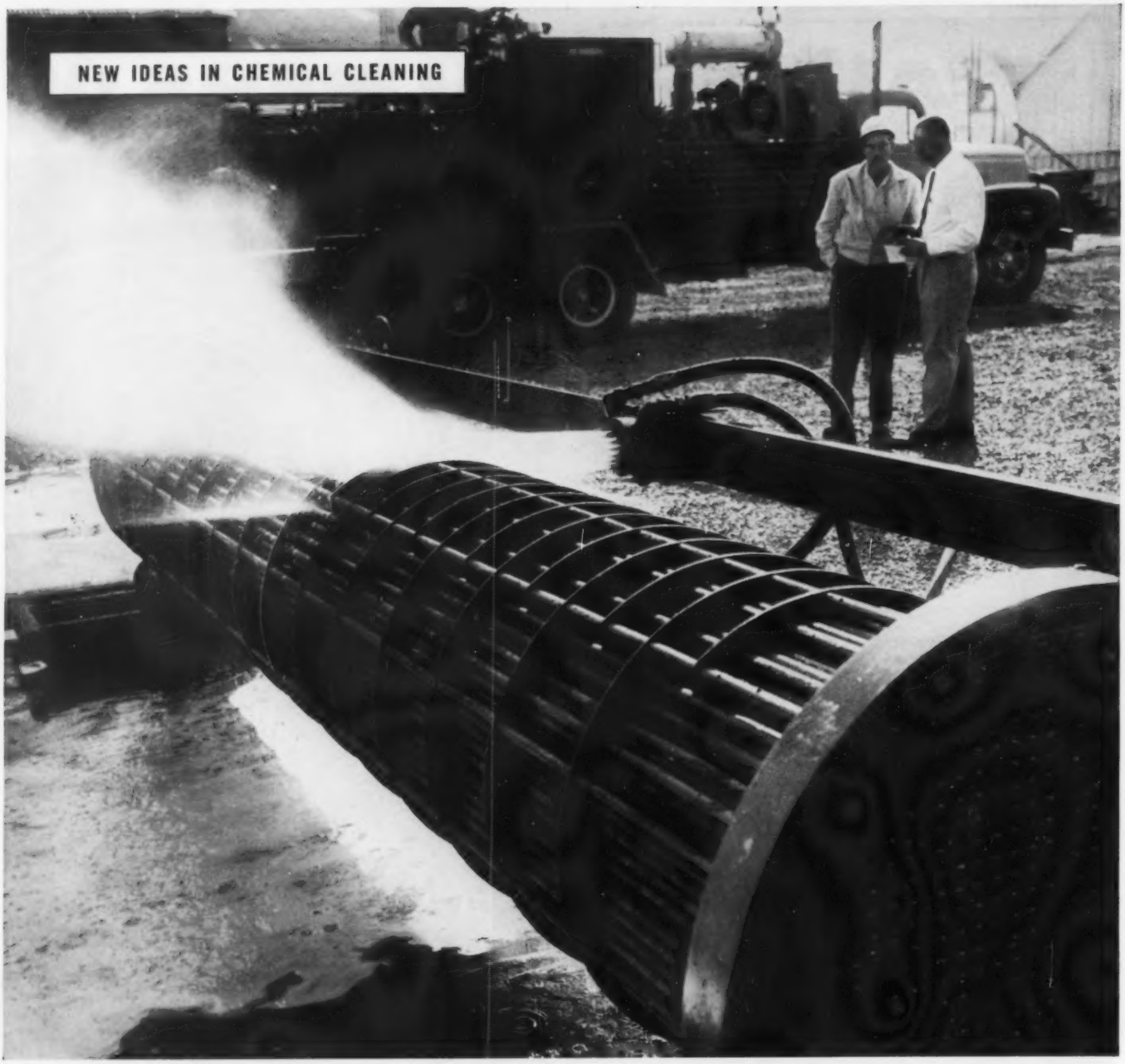
begins with Allis-Chalmers electrical equipment coordination

Proper application . . . efficient use of electric power — these are essential ingredients to peak mill output. No single piece of equipment in a process line can guarantee this result, for its performance depends on the accurate function of other devices.

Allis-Chalmers equipment is matched to mill standards for maximum performance. Blooming mills, hot-strip mills — wherever electric power is used, Allis-Chalmers coordinated engineering is the key to higher efficiencies . . . increased yield . . . a finished product of the highest quality.

Allis-Chalmers is helping steel mills with their new plant and modernization programs. Many have improved output and product quality without the cost of major plant alterations.

There's an Allis-Chalmers steel mill specialist near you. *Call him direct, or write* ***Allis-Chalmers,*** *Industrial Equipment Division, Milwaukee 1, Wis.* A-1272



New Jetting Tool To Clean Tube Bundles Saves Thousands Of Dollars

The new high-pressure hydraulic tool, shown above, is currently saving thousands of dollars for companies in the refining, chemical, and petrochemical industries. It is the jetting tool developed by Dowell to remove deposits from heat exchanger tube bundles.

Previous methods of cleaning these bundles have been costly, time-consuming and often inadequate. Many times bundles had to be replaced completely because of the lack of a suitable cleaning method.

This new tool has a remarkable record of thorough, fast cleaning. For example, a slurry reboiler exchanger bundle, three feet in diameter and 16 feet long, was fouled with deposits of coke and asphalt. After being jetted from only one side, the bundle was thoroughly clean. Time required: less than one hour.

The tool holds the bundle in place for cleaning and has flanged rollers for rotation. The jet-head is manipulated automatically so that all tube spaces are covered. The jetted liquid can be either water or chemical solvents.

The new Dow Industrial Service Division will continue to offer the service which was formerly provided through the Dowell Division. For engineered recommendations to solve your cleaning problems contact the field office nearest you, or write Dow Industrial Service, 20575 Center Ridge Road, Cleveland 16, Ohio.

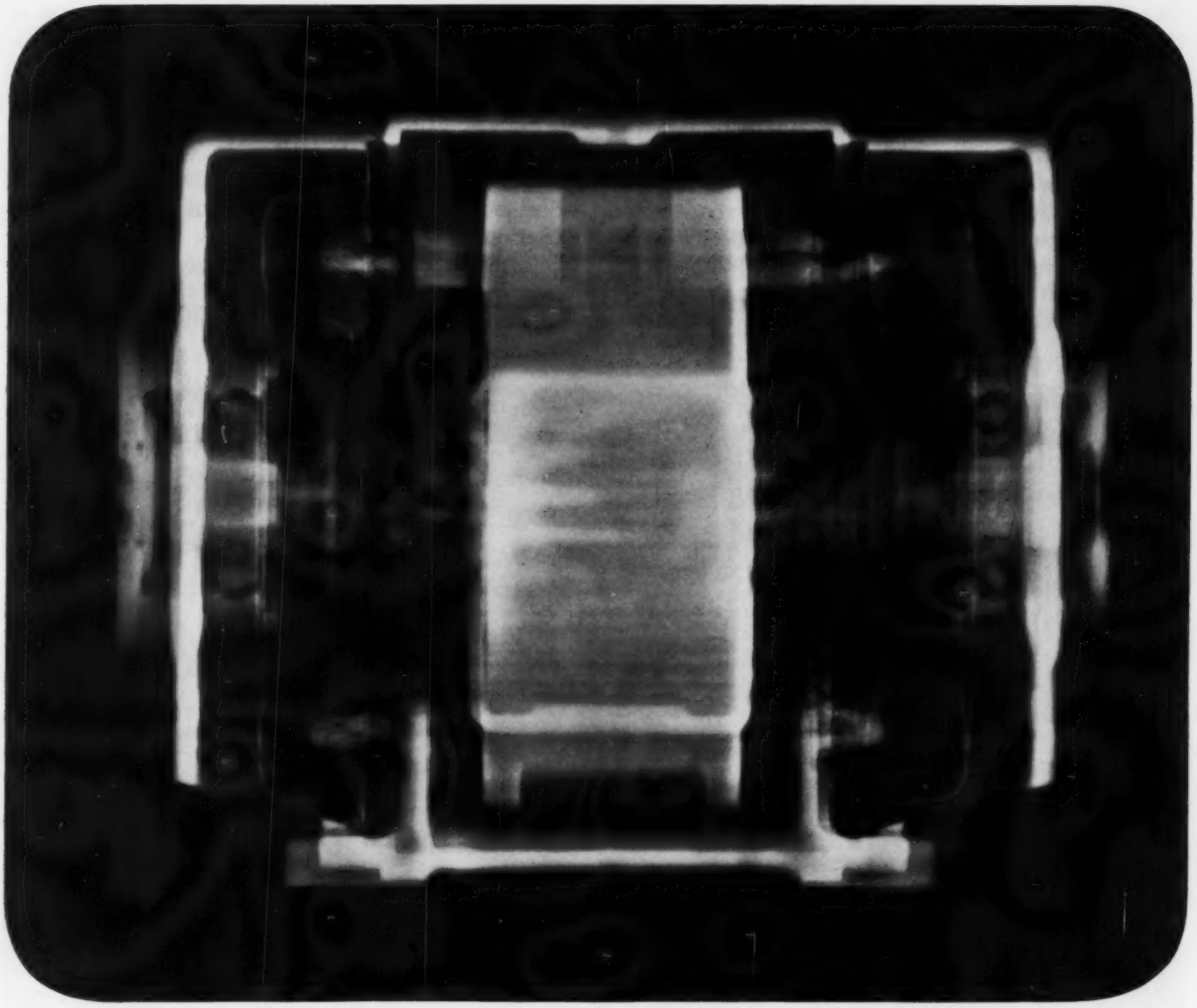
DOW INDUSTRIAL SERVICE

DIVISION OF THE DOW CHEMICAL COMPANY

DOW

ALLIS-CHALMERS

A-1337



Actual radiograph of a 5-hp open-type motor taken with a 24-million volt Allis-Chalmers Betatron.

X-ray view of motor health

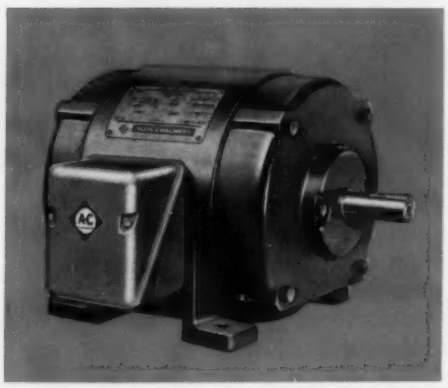
Invisible standards of perfection increase life expectancy of every Allis-Chalmers motor

The exceptionally long performance of A-C open motors proves the value of thinking *beyond* established standards of design . . . of taking "significant new achievement" as the ideal.

This ideal led to many refinements for A-C open motors: double-shielded bearings that keep dirt out and allow controlled migration of grease, permanently numbered lead spacer and leads for easy identification and connection, and heavy-duty cast iron frames that resist corrosion and keep rotating parts perfectly aligned.

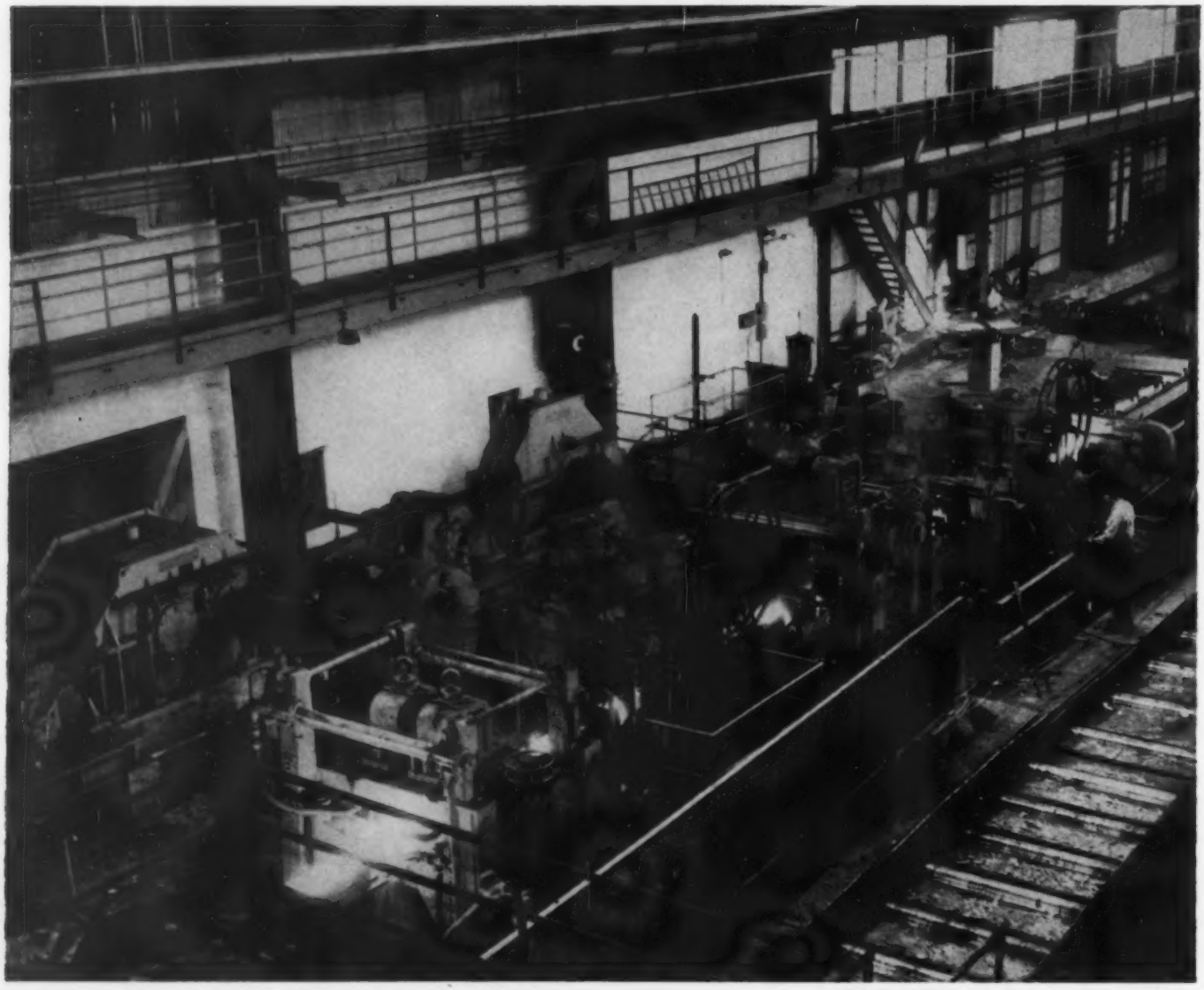
For totally-enclosed, open-type and *Super-Seal* general purpose motors, and electrically or mechanically modified definite-purpose motors, choose the motor built to invisible standards of perfection. Choose A-C. Special application help available.

Call your nearby A-C representative. Or write **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wis.* Super-Seal is an Allis-Chalmers trademark.



New, faster **BIRDSBORO** *20" Continuous Mill produces up to 100 tons per hour*

This 20" Continuous Mill engineered and built by Birdsboro for Aristoloy Steel Division of Copperweld Steel has two vertical and two horizontal roll stands. The use of vertical and horizontal stands permits the mill to roll rounds, squares and flats without twist guides. The use of bevel gear angle drives for the vertical stands permits placing all the main mill motors on the same level in the motor room. Copperweld has successfully rolled 5-inch squares, although design capacity is 2½" to 4¾" squares. The mill is designed to take blooms rolled direct from the ingot by the breakdown mill without reheating. Even high chrome nickel grades of steel that normally require reheating after reduction to 5- to 7-inch squares can be reduced direct to the smallest billet sizes without reheat. The installation of this Birdsboro mill with its many design extras has helped give Copperweld new flexibility of production while reducing costs. Birdsboro custom engineering can solve your production problems and open new profit doors for your mill operations. *Sales Department, Engineering Department and Mfg. Plant:* Birdsboro, Pennsylvania; *District Office:* Pittsburgh, Pennsylvania.



MM79-59

BIRDSBORO
CORPORATION

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Foreign Digests

Complete translations from which these condensations were prepared are available from Henry Brutcher, P.O. Box 157, Altadena, Calif., to whom all correspondence should be addressed.

"STUDY OF THE BEHAVIOR OF IRON ORES DURING SINTERING—PART II"

by W. VON DEM ESCHE and O. STEINHAUER, Metallurgical Department, Westfalenhutte, A.G., Dortmund, Germany. (Translation No. 4725 from Archiv Eisenhüttenwesen, Vol. 30, 1959, No. 4)

Δ DETERMINATION of softening point of iron ores during sintering by various methods: in boats, in crucibles, under higher or lower loads or without load. Testing setup. Studies of softening behavior in hot-stage microscope (hemispherical point in various atmospheres). Deviations of the various softening test results from the sinter-formation temperature. Advantages of hot-stage microscope procedure for commercial practice.

General discussion—General applicability of the new test methods developed by authors. Empirical nature of determination of sinter-formation temperature, based on structural changes induced by melting and precipitation reactions. Softening of ore being sintered vs softening of sinter in blast furnace. Agreement between degree of oxidation determined by analysis of oxides, and crystallographic findings.

"BLAST FURNACE STOCK LEVEL INDICATED BY ULTRASONIC MEANS"

by YU. YA. TREISTER. (Translation No. 4676 from Metallurg, May, 1959)

Δ THE central automatic instrument laboratory worked out two forms of ultrasonic stock indicator: one with a gas jet ultrasonic generator, and one with a magnetostrictive generator. A magnetostrictive vibrator was used as receiver. A magnetostrictive generator is operationally reliable.

In 1957, an ultrasonic stocklevel indicator was mounted on a blast furnace at the Dzerzhinskii plant. The power of the ultrasonic radiation was 2.5 times that of the experimental indicator. To increase the sensitivity of the apparatus and to secure stable operation, a polarization unit was introduced, feeding d-c to the vibrator.

Tests on the apparatus showed that, to obtain a reliable signal up to 10 to 13 ft the power of the ultrasonic radiation must be greatly increased, but there is no point in increasing further the sensitivity of the receiver, since the furnace itself produces quite a few interference signals.

At present, the central automatic instrument laboratory is developing a more powerful ultrasonic apparatus (up to 3 kw) with its output fed to a standard potentiometer.

OTHER AVAILABLE TRANSLATIONS

"Briquetting of Iron Ores with the Use of Basic Fluxes," by W. Petersen and S. Wawroschek, Stahl und Eisen, vol. 79, 1959, No. 19. Briquetting of iron ores once more an economical proposition. Methods of determining mechanical strength of ore briquets and behavior in blast furnace. Ore briquetting processes in current use or still to be tested: results of briquetting trials using sulphite liquor, cement, or bitumen as binders. Layout of modern plant for making flue dust + sulphite liquor briquets. Basic additives for a process giving briquets well able to stand up under transportation, storage, and in blast furnace, without requiring any pre- or post-treatment. New developments in briquetting presses: mold design; eccentric roll presses; extrusion presses. Proposed up-to-date ore briquetting process holding considerable promise; layout of plant. (Translation No. 4700)

"Degassing of Steel in Ladle and Mold with Direct Electric Current," by V. I. Yavoiskii and others. 'Proizvodstvo i Obrabotka Stali i Splavov' Sbornik 38. Metallurgizdat, 1958. Exploration of feasibility and advantages of degassing steel in ladles and molds with the use of direct current. Current densities employed. Degassing of basic open-hearth carbon and alloy steels in molds: setup; mode of introduction and time of passage of d-c. Study of ingots poured with and without d-c treatment for flakes, chemical heterogeneity, macrostructure; distribution and amount of hydrogen, nitrogen and oxide and sulphide inclusions. Sampling and analysis procedures for hydrogen and other gases. Degassing of steel in ladle: arrangement; two methods of degassing. Results: hydrogen content; oxygen, nitrogen. Advantages of degassing with d-c especially for large killed-steel ingots. Best method of using direct current for degassing of steel. (Translation No. 4626)

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Limit fault current to very low values

Hold 500% load for minimum of ten seconds

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or modernizing old installations—

GET ALL THE FACTS

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Operator reads Speedomax H chart record

Hot ingot is pulled at Inland

New Trend in Soaking Pit Practice

Accelerated heating of Inland Steel's biggest ingots

Fast heating of giant 20-ton ingots, close temperature control and excellent scale deposition are some of the advantages that Inland Steel is getting from 6 batteries of 18 new Salem-Brosius soaking pits at Indiana Harbor Works.

These advantages are, in part, gained by new accelerated heating systems that feature the Speedomax® Type H temperature controller.

When cold ingots are charged, the pit operator sets a predetermined accelerated heating program by means of a timer on his central control panel. During the period of fast heating, extra fuel is supplied to the pits, driving pit temperature to an accelerated control point. This higher point is determined by metallurgical conditions and may be reset as conditions demand. As the ingot soaks up this extra heat, and the fast-heating period is completed, fuel is cut back and Speedomax H returns the pits to normal control temperature for the remainder of the soak period.

Because of this efficient control system, heat-up time is cut and the production of ingots is increased, assuring that the new rolling mills can operate at maximum output.

Because of their reliability, L&N temperature control instruments are specified by a majority of soaking pit users and manufacturers. So, when you modernize—or build soaking pits—ask your L&N Field Engineer to show you what L&N temperature controls . . . and our equally dependable combustion controls . . . can do for you. Or write to 4942 Stenton Avenue, Phila. 44, Pa.

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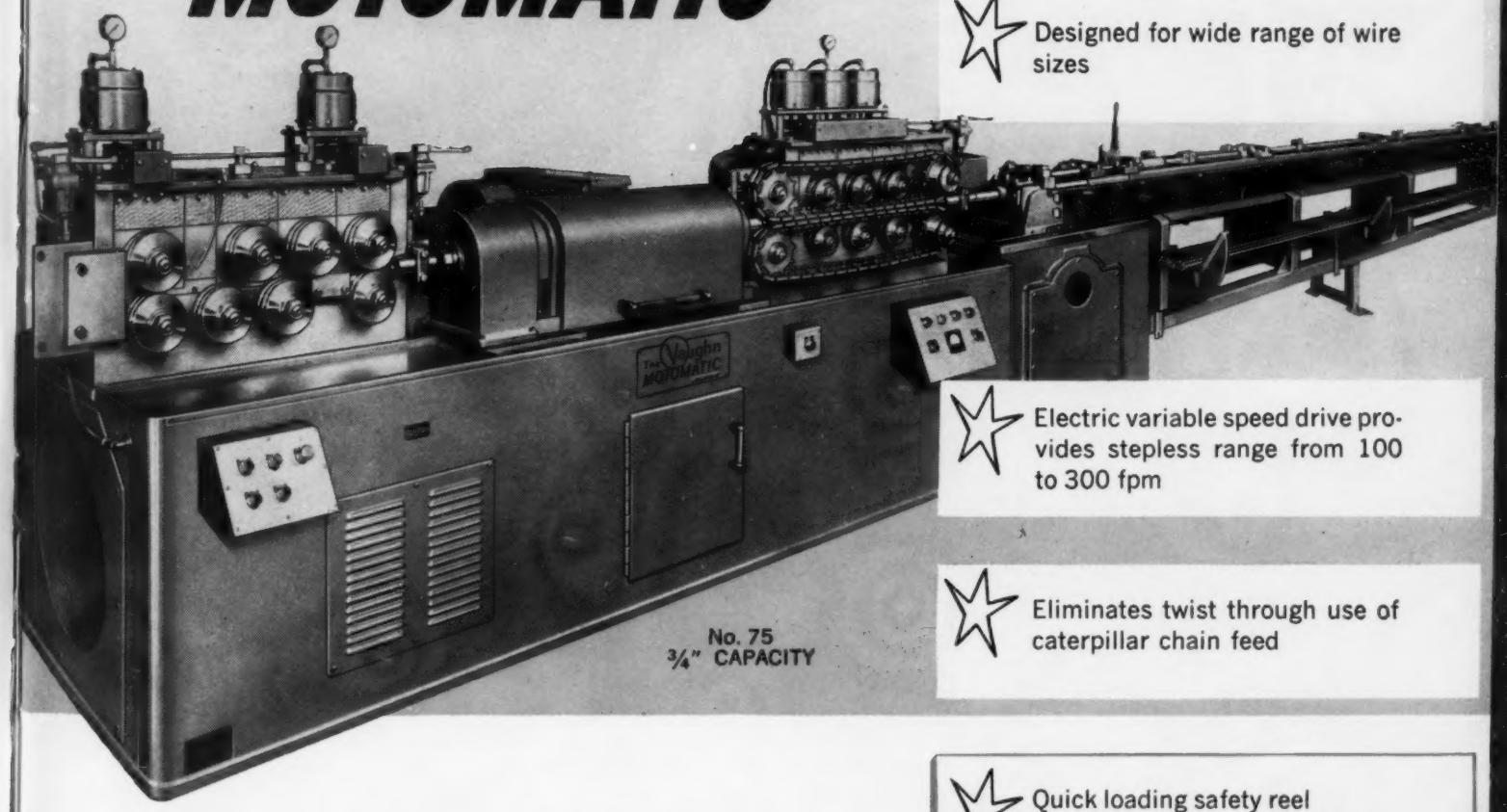

- Delivers uniform diameter bars and precision-cut lengths
- Designed for wide range of wire sizes
- Electric variable speed drive provides stepless range from 100 to 300 fpm
- Eliminates twist through use of caterpillar chain feed

This efficient Vaughn machine affords automatic production of straight, cut lengths direct from the coil, processing the entire coil from end-to-end, and reducing scrap to an absolute minimum. Built to high Vaughn standards of smooth operation, low maintenance and long service life, the Motomatic increases production while reducing labor time and fatigue—a dividend-paying investment year after year. • Send for Motomatic Bulletin No. 751.

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COMPLETE COLD DRAWING EQUIPMENT . . .
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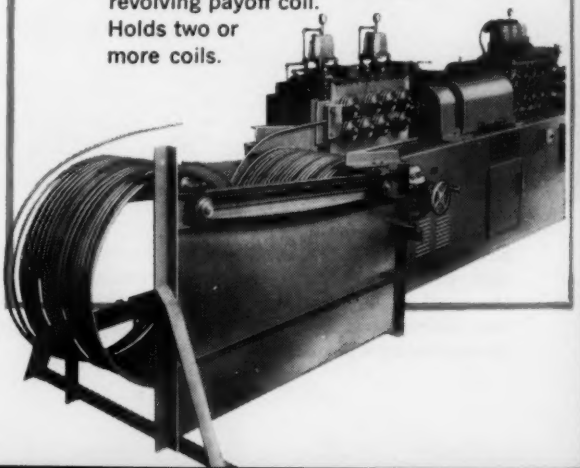
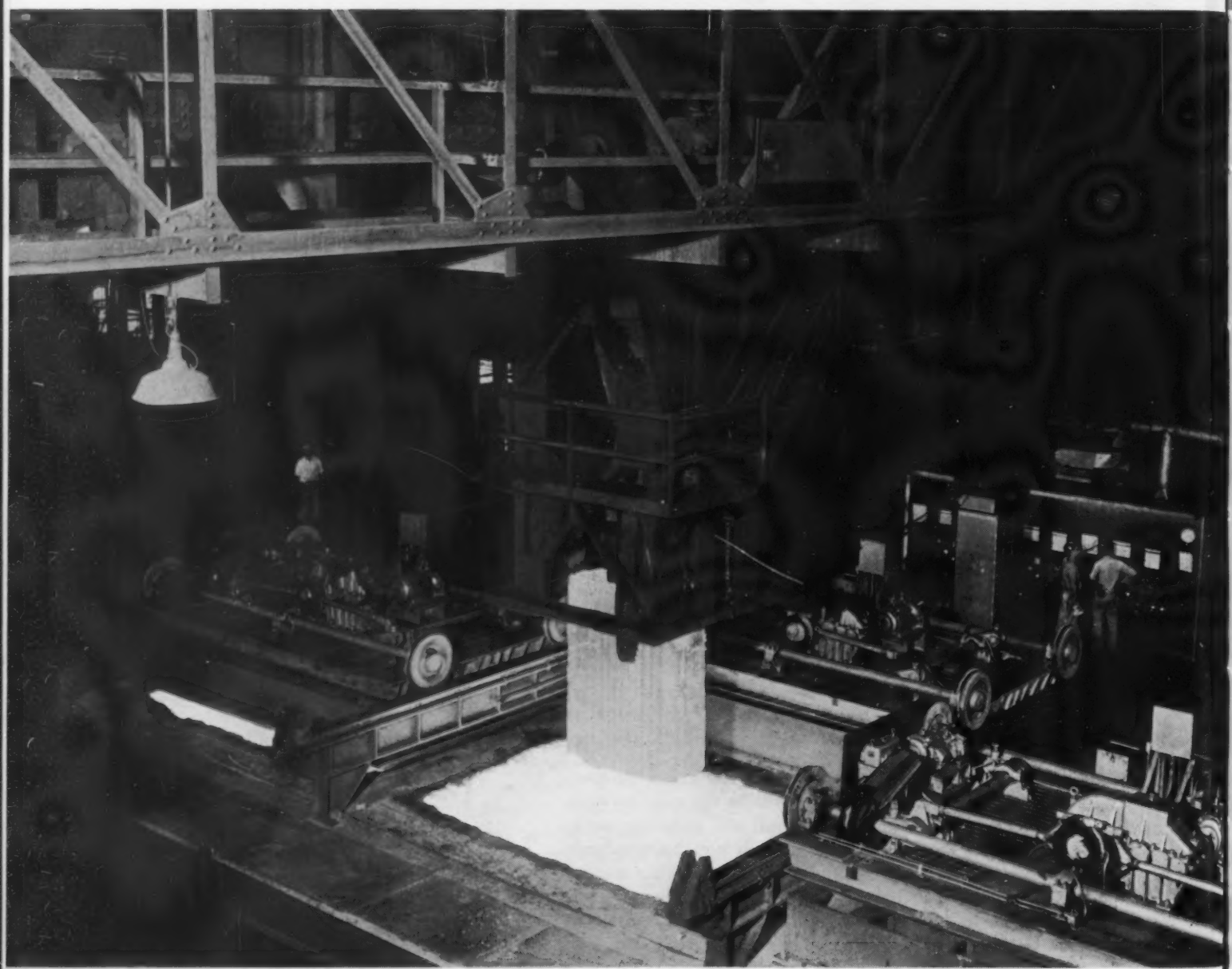
- Quick loading safety reel –facilitates starting wire coils into machine and protects operator from revolving payoff coil. Holds two or more coils.



For highest performance requirements . . . on installations of every size

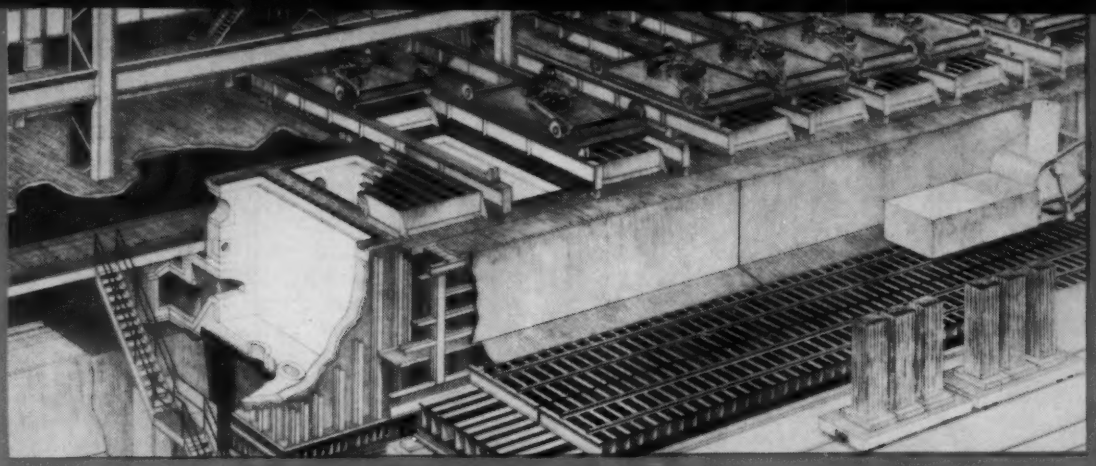
SOAKING PITS

with new features



1 of 51 Swindell Pits installed in a large Midwestern steel plant

Engineering Service Swindell-Dressler Corporation provides a complete engineering service for the steel industry in the design and construction of new plants, and modernization of existing facilities. Consultations arranged gladly on request.



by SWINDELL-DRESSLER

Swindell-Dressler leadership in furnace design and construction for the steel industry is exemplified fully in our many recent Soaking Pit installations. Currently under construction are two more large Swindell projects to increase further the soaking pit capacity of a major steel producer.

Let us consult with you on the advantages of air at high pressure and temperature, efficient use of blast furnace gas, and outstanding space-saving features . . . all with the well-known rugged Swindell-Dressler construction developed by our many years of steelmill experience.

SWINDELL-DRESSLER CORPORATION

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The SWINDELL-DRESSLER CORPORATION of Canada, Ltd.,
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ANNOUNCING A NEW CORPORATE NAME

for The Garlock Packing Company

Garlock Inc. becomes the new name for The Garlock Packing Company, Palmyra, N. Y., to reflect more accurately its broad diversification of products and markets.

Originally established to manufacture mechanical packings, Garlock now produces over 2,000 different styles of packings, gaskets, seals, molded and extruded rubber and plastic products for every major industry.

The new corporate name, Garlock Inc., more closely identifies this 73-year-old company with the growth and development of its product lines. *Today, industry goes to Garlock for such widely diversified products as:*

- Hydraulic-Pneumatic Packings
- Oil and Grease Seals
- Gasketing and Expansion Joints
- Braided Packings
- Molded and Extruded Rubber Parts
- Plastic Stock Shapes and Fabricated Parts
- Mechanical Seals for Rotating Shafts
- Metal Packings
- Leather Packings
- Electronic Components
- Dry Bearing Materials
- Fluorocarbon Tank Linings
- Missile and Rocket Components

To help you in selecting or applying these products, Garlock offers the services of over 126 thoroughly-trained sales engineers, 175 electronic component manufacturers' representatives, 180 authorized bearing distributors and 69 foreign distributors. Conveniently located warehouses and stocking points assure Garlock customers of prompt delivery.

At Garlock Inc., design and development of new or improved products and materials is an ever-present objective. To this end Garlock maintains extensive research and laboratory-test facilities. In addition, Garlock engineers and chemists are always ready to work with you in seeking solutions to tough application problems.

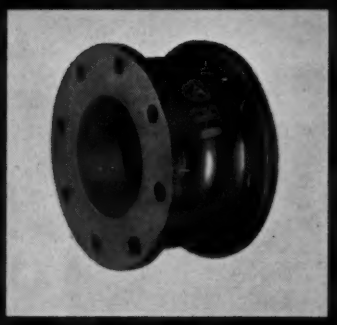
GARLOCK

To find out more about "the new Garlock," call the nearest of our 26 sales offices, or write to Garlock Inc., Palmyra, N. Y. *To assure prompt attention,* please refer to *Garlock Inc.* on all future correspondence and orders.

Canadian Div.: Garlock of Canada Ltd.

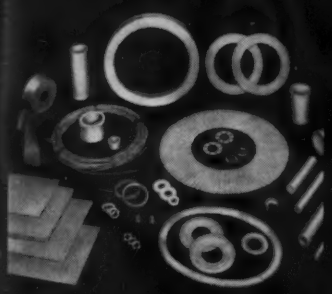
Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

Hydraulic-Pneumatic Packings



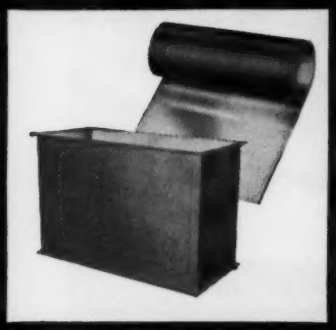
Expansion Joints

Molded and Extruded Rubber Parts



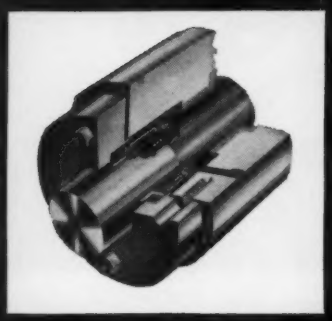
Plastic Stock Shapes
and Fabricated Parts

Braided Packings

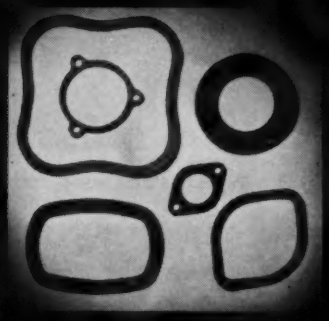


Fluorocarbon Tank Linings

Oil and Grease Seals



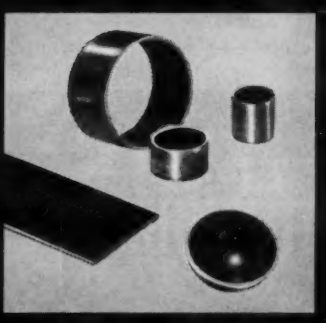
Mechanical Shaft Seals



Gasketing

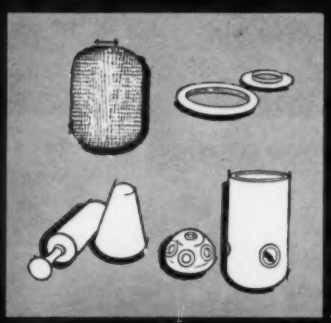
Spiral Wound Gaskets

Metal Packings

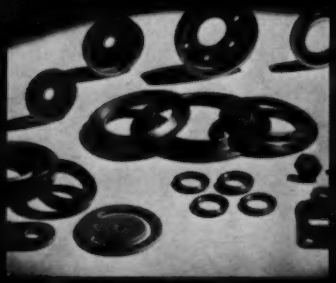


Dry Bearing Material

INC.

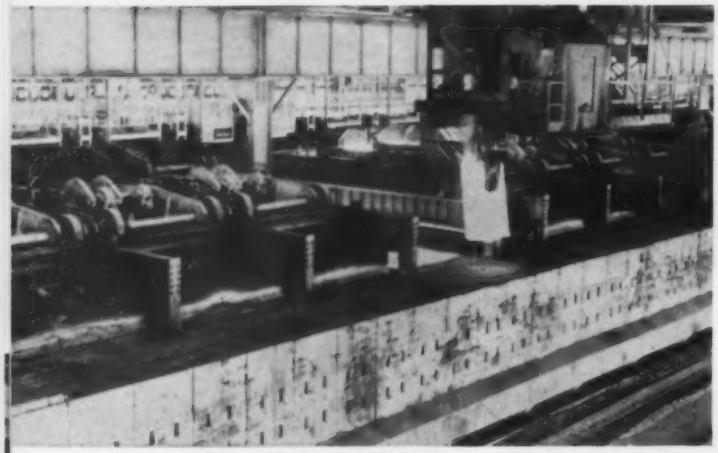


Missile and Rocket Components

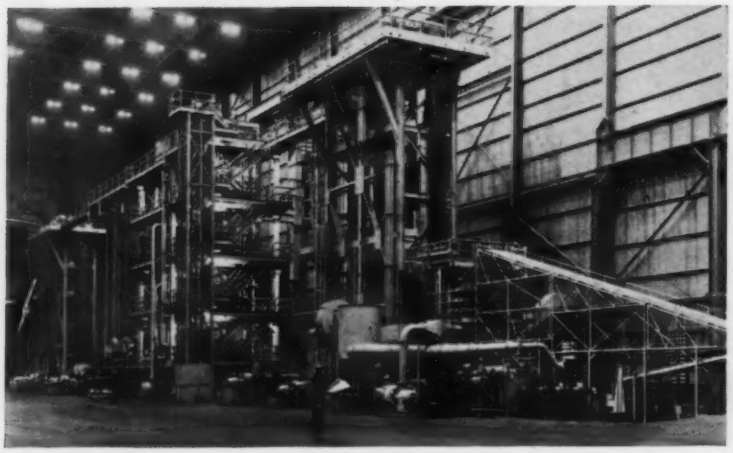


Leather Packings

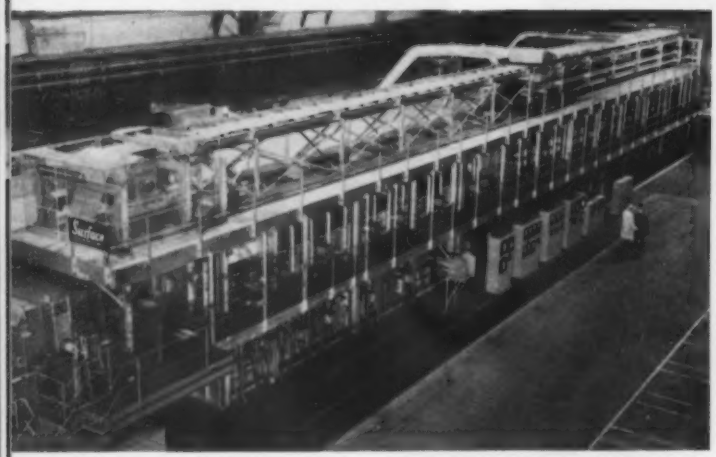
Electronic Components



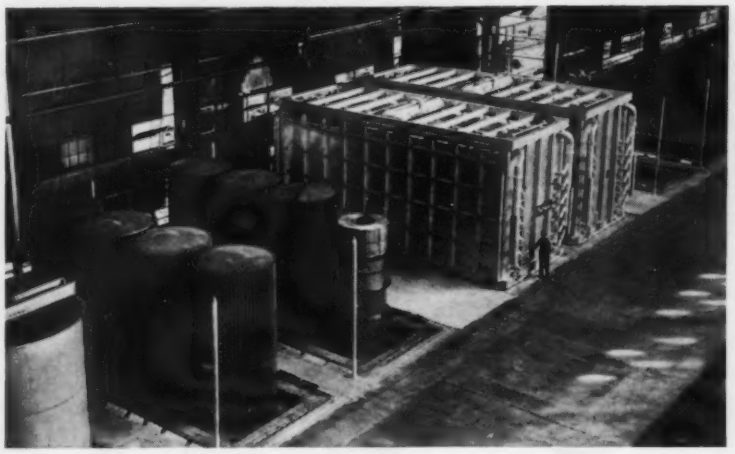
48 soaking pits installed at one time.



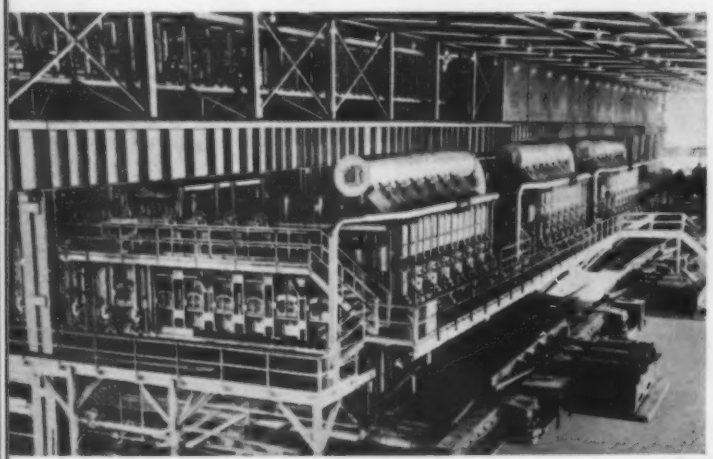
Continuous tin plate annealing line.



Normalizing line for enameling strip.



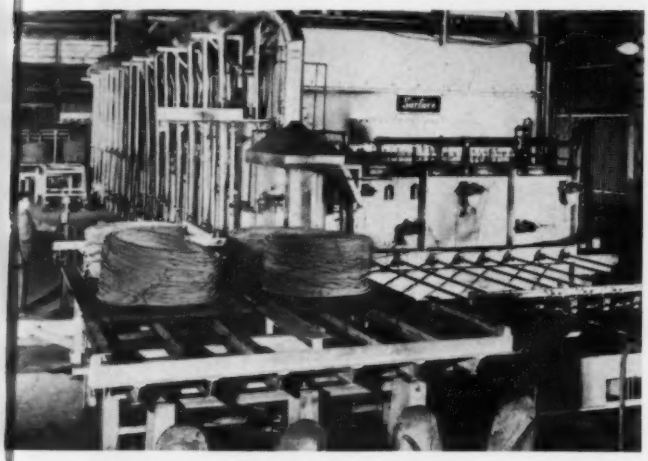
Multiple-stand annealing covers.



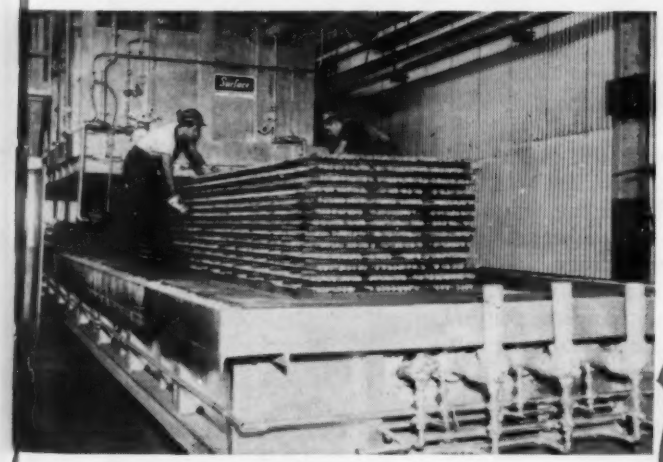
World's largest slab-heating furnaces.

Continuous strip galvanizing line.

Single-stand radiant tube annealers.



Annealing, carbon restoration furnace.



Car-bottom rod and bar furnace.

PROVING GROUNDS

for steel profits

Surface Combustion's proving grounds—a few of which are shown at the left—include virtually every rolling mill in North America plus a considerable number abroad.

You can sample here the variety of Surface equipment which has passed the toughest tests on the steel mill floor: checked out for quality, shaken down for reliability, and—most important to you—proved out for profitability.

With internal costs and external competition on the rise, it will pay you more than ever before to specify the services and equipment of a company which has repeatedly passed the tests in steelmaking's ultimate proving grounds. Surface Combustion, 2404 Dorr Street, Toledo 1, Ohio.

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to carry load peaks economically... Lukens Steel chose Pennsylvania triple-rated transformers

Two 30/40/50-mva units serve 25-million kwhr monthly load

Power needs at Lukens Steel Company's Coatesville, Pa., plant vary considerably during the three-shift, round-the-clock production of steel plates, heads and plate shapes. The total monthly consumption of 25-million kwhr represents an average load of more than 2500 kw—with a half-hour power demand of approximately 55,000 kw.

To carry load peaks economically, Lukens Steel equipped its substation with two *triple-rated* Pennsylvania power transformers. The self-cooled rating of 30 mva is automatically increased, when required, to forced-air ratings of 40 and 50 mva. Fans are actuated automatically when plant activity necessitates the additional transformer capacity.

Both transformers have the inherent ruggedness needed to withstand sudden load surges. One transformer supplies power to a 100-ton electric arc furnace installation. The other handles general plant load plus the load of a slabbing mill and four rolling mills—including a 206-inch rolling mill capable of producing the widest and heaviest steel plate in the world. Under emergency conditions, the second transformer supplies the electric furnace bus in addition to handling its normal load.

One of two 30/40/50-mva Pennsylvania Power Transformers serving the Coatesville plant of Lukens Steel Company. High voltage: 138,000△ volts, with two 2½%± full-capacity taps. Low voltage: 13,800Y/7980 volts.

PENNSYLVANIA TRANSFORMER DIVISION
McGRAW-EDISON COMPANY • CANONSBURG, PA. • Greater Pittsburgh District

Initial selection of a rolling oil must consider lubricity, wettability, detergency, freedom from staining and corrosion . . . . it is also vital to maintain proper solution concentration and freedom from contamination . . . . Acme has also been successful in using the rolling oil for bearing lubrication on the same mill.

the selection and use of A Water Soluble Rolling Oil

by PAUL W. COFFMAN,
Assistant General Superintendent
Riverdale Plant
Acme Steel Co.,
Chicago, Ill.

ANY discussion on the use of soluble oils which are used in cold reduction of steel is necessarily somewhat controversial, and it should be kept in mind that the practices which have been evolved at the Acme Steel Co. are the result of development and experimentation on our own particular products and equipment. In other situations, these practices may or may not be usable, and possibly, in the final analysis, each operating problem may be unique.

We began a systematic program for the selection and testing of soluble rolling oils in 1953, and since that time, 26 products from 10 different companies have been tested. The program is still being continued. Because of the variety and nature of the products rolled, our requirements of rolling oils are quite exacting, possibly more so than many other producers of cold rolled steel feel necessary. However, we firmly believe that the proper selection and use of a water soluble rolling oil can contribute substantially to better quality and increased production, and much time and energy have been devoted to the subject.

The Acme Steel Co. is a producer of specialty hot and cold rolled strip steel, steelstrap, strapping machinery and miscellaneous consumer products. Our cold rolled strip steel is produced in all commercial tempers and finishes, including No. 3 finish for plating requirements, in widths up to 27 in. Cleanliness and freedom from scratches and rust are paramount requirements for this product, and the rolling solution plays a major part in these characteristics. It is essential that the rolling solution provides adequate lubricity and cooling for high-speed rolling of these products, and at the same time, reduces the hazard of scratching the steel. The rolling solution must have sufficient detergent action as to leave the steel clean and bright, and to minimize any undesirable residue which may remain after annealing. Along with these characteristics it must also provide enough rust inhibition so that coils can be stored for prolonged periods of time between operations without danger of corrosion.

Much of our production of cold rolled strip steel is for steelstrap and other miscellaneous products which have no further rolling after the initial cold reduction. It is essential then that the rolling solution permit the rolling of such material at maximum speed while maintaining good shape and freedom from edge cracking.

The complexity of the problem is further aggravated by the extreme variety of products which are rolled on our cold reduction mills. Carbon and alloy grades of cold rolled strip steel in gages as light as 0.002 in., and as heavy as 0.200 in., widths to 27 in., and in a variety of surface finishes, are cold reduced using essentially the same rolling solution. Thus it can be seen that con-

Figure 1 — Initial test work was done on the single stand 5½ x 18-in., 4-high mill.

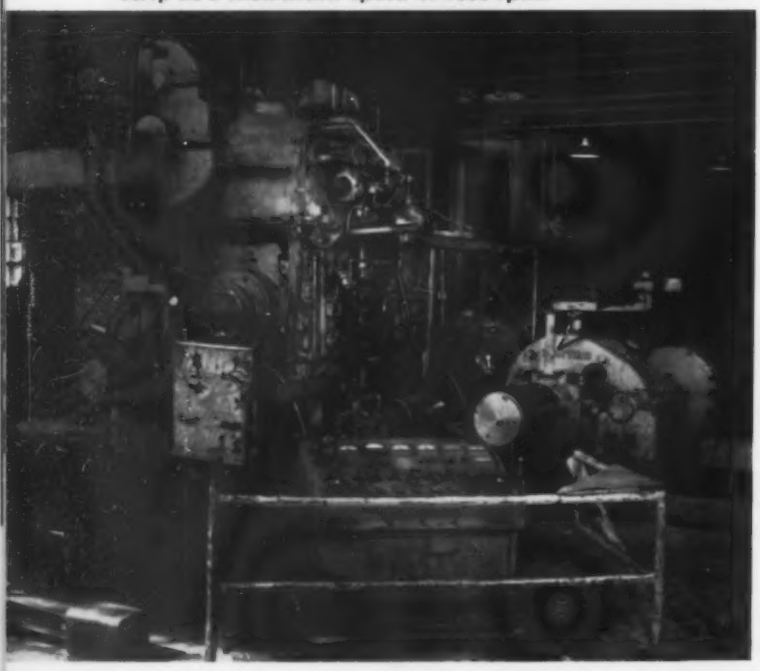
tinued research into rolling oils is important to us from both the standpoints of quality and improved efficiency.

REQUIREMENTS OF A SOLUBLE OIL

In the selection of a soluble rolling oil, the following characteristics are considered to be of importance:

1. The oil must be readily water soluble and suitable for use in a recirculating system. It must go easily into solution and must readily form a stable homogenous emulsion.
2. The emulsion must have sufficient lubricity to reduce friction, but not so much as to cause difficulty in starting ends of coils into the mill.

Figure 2 — Acme has a 14 x 29-in. reversing mill which rolls strip at a maximum speed of 1550 fpm.



3. The emulsion must have adequate wettability.
4. The emulsion must be able to perform equally well at temperatures between 80 and 130 F.
5. The emulsion must permit maximum reduction and speed of rolling without causing heat build-up or shape problems. Low carbon steels are given 85 per cent reduction and are finished at 3000 fpm on the five-stand tandem mill.
6. The emulsion must act as a lubricant for work roll bearings on the four-high mills and for the backup bearings on the sendzimir mill.
7. The emulsion must be able to withstand centrifuging without breaking down.
8. Since we do not clean our strip prior to anneal or further processing, the emulsion must leave the steel as clean as possible after cold reduction. Oil or dirt left on the steel must burn off during anneal without leaving an undesirable residue.
9. The emulsion must afford sufficient rust protection that the coils can be stored up to six weeks in a heated mill building without undue danger of corrosion.
10. Life of the emulsion must be such that the oil is economical to use.

FACILITIES

Soluble oil rolling solution is used on five different cold reduction mills at the Riverdale plant of the Acme Steel Co.; a small single-stand four-high mill, a single-stand four-high reversing mill, a four-stand, four-high tandem mill, a five-stand, four-high tandem mill and a sendzimir mill.

5½ x 18-IN. FOUR-HIGH MILL

The 5½ x 18-in. mill is a small single stand mill, equipped with 19-in. diam backups, and is used primarily for light reductions on strip up to 10-in. wide. See Figure 1. It is powered by a 200-hp motor and is capable of rolling at 400 fpm. Reductions are limited to about 20 per cent. The mill is equipped with a recirculating system for soluble oil; however, rolling solution, except for test purposes, is not normally used on this unit.

14 x 29-IN. REVERSING MILL

The 14 x 29-in. reversing mill was built and installed in 1938. (Figure 2). The mill is equipped with 33-in. diam backup rolls which rotate in oil-film bearings. The work roll roller bearings are lubricated with a soluble oil emulsion.

The main mill drive is a 2000-hp synchronous motor which drives a 250-volt, d-c generator for the mill motor, and two 250-volt, d-c generators for the reel motors. The rolls are driven from a 1000-hp 500 to 1000-rpm mill motor, through reduction gearing of 2.45 to 1. The reels are each driven through 250-hp, 300 to 1200-rpm motors. The 10-in. diam housing screws are each powered by 10-hp 800-rpm motors. The mill rolls strip steel in gages of 0.009 to 0.200 in., in widths up to 27 in., at a maximum speed of 1550 fpm.

Rolling solution is supplied to the mill from a 4500-

gal supply tank, through two 25-hp motor-pump units, each having a capacity of 200 gpm. Solution is delivered at approximately 40-psi pressure, and is kept at a temperature of approximately 100 F, with maintenance of temperature achieved with a 200-gpm cooler. The solution is kept clean by the use of a pressure filter and a 600 gphr capacity centrifuge.

FOUR-STAND TANDEM MILL

The four-stand tandem mill was put into production in 1940. It is a four-stand, four-high mill with 14¼ x 22-in. nominal size work rolls and 29 x 22-in. backup rolls. The mill is capable of rolling gages from 0.006 to 0.062 in., in widths to 18½ in., at a maximum speed of 2574 fpm.

Top and bottom backups on stands 1 and 2, and bottom backups on stands 3 and 4 are equipped with oil-film bearings. Top backups on stands 3 and 4 have roller bearings. All work roll roller bearings, as well as the drive spindles, are lubricated with the rolling solution. This is a somewhat unorthodox approach to the lubrication of work roll bearings, and it may not have the sanction of many lubrication engineers. Some years ago, it was our good fortune to have a cold mill superintendent with the courage and initiative to make the experiment, and the results have been gratifying. Lubrication is simplified, bearing life is good and there is no danger of solution contamination from work roll bearing lubricants.

One 2500 hp synchronous motor driving a 600-volt, d-c generator furnishes power for the complete mill with the exception of the screwdowns. Each of the four mill stands are driven by 500-hp, 350 to 1050-rpm motors through suitable reduction gearings. The reel motor is 150 hp, 300 to 1200 rpm.

The rolling solution is supplied to the mill from a 4400-gal storage tank by three 300-gpm pumps, each driven by 15-hp motors. The working pressure at the mill is about 30 psi, and solution is maintained at a temperature of about 100 F by means of a cooler. Solution cleanliness is maintained by a filter and a 1200-gal per hr centrifuge.

FIVE-STAND TANDEM MILL

The tandem mill (Figure 4) was built and put into production in 1948. It is a four-high, five-stand mill, using 14-in. diam work rolls and 33-in. diam backup rolls with 22-in. wide face. The mill is capable of rolling gages from 0.0075 to 0.050-in. in widths up to 19 in. at a maximum speed of 3000 fpm. Backups are equipped with oil-film bearings. The work roll roller bearings and drive spindles are lubricated with the rolling solution.

One 4350-hp synchronous motor drives three 1000-kw, d-c generators for power for stands 1, 2 and 3. Another 3275-hp synchronous motor drives two 1000-kw, d-c generators for stands 4 and 5, and one 250-kw, d-c generator for the coiler motor. Each of the five stands is directly driven by a 1250-hp motor at speeds ranging from 90 to 270 rpm in No. 1 stand to 400 to 800 rpm in No. 5 stand. There are no reduction gears. The coiler is powered by a 300-hp 150 to 750-rpm motor.

There are two duplicate coolant systems on the mill,

Figure 3 — Four-stand tandem mill has 14½ x 22-in. work rolls and 29 x 22-in. backup rolls. Work roll roller bearings as well as drive spindles are lubricated with the rolling solution.

which can be used together or separately. Each system is serviced from a 10,000 gal supply tank, and coolant is supplied from each tank by two 50-hp, 1000-gpm centrifugal pumps. Rolling solution is supplied at a pressure of about 50 psi and is maintained at a temperature of 120 F by a 750-gpm cooler.

SENDZIMIR MILL

The 13-in. sendzimer mill (Figure 5) was installed in 1954. It is a 1-2-3-4 type mill, using 1.125-in. nominal diameter work rolls, 2.0-in. first intermediate rolls, 3.6-in. second intermediate rolls and 6.299-in. backup

Figure 4 — Five-stand tandem mill has oil-film backups and roller bearings on work rolls.

Figure 5 — The 13-in. sendzimir mill rolls at speeds up to 1200 fpm.

bearings. The mill is powered by a 500-hp motor and each reel is powered by a 300-hp motor. This mill rolls carbon and alloy steels in finished gages of 0.002 to 0.125 in., in widths to 14 in., at a maximum speed of 1200 fpm.

Soluble oil coolant is supplied to the mill from two 3000-gal tanks, at a volume of 300 gpm and pressure of 140 psi. Temperature is maintained at about 130 F.

METHODS OF EVALUATION

An intensive investigation of the availability and suitability of rolling oils was started in early 1953. Various manufacturers and suppliers of rolling oils were contacted and meetings were arranged to discuss their products. By May, 1953, selections had been made and tests were started. Since that time, twenty-six products from ten different companies have been evaluated. In addition, many other companies have approached us to discuss their particular product.

Consideration for testing has been based on the reliability of the supplier and the extent of his experience in the field. At the same time, only water soluble lubricants, suitable for use in a recirculating system, were judged to be applicable. In other words, it was decided not to test materials primarily designed for precoating after pickling and/or direct application on the mill.

Testing was then broken down into two phases; namely, an experimental rolling on the small single-stand mill and then, if passable, a production trial on the five-stand mill. The reason for a two-stage test was centered around the types of products produced in our Riverdale plant. Although these products are not too far different than those produced in many plants throughout the country, the fact that most of them can and must be rolled on any of the five reduction mills complicates the problem somewhat. For that reason, it is essential that any rolling lubricant be universally usable on all the mills without alterations. In addition, the first stage tests on the single stand mill minimize the risks involved in a large scale run on a high-speed production mill.

Evaluation of the rolling oil by use of the single-stand mill was made solely to determine the suitability of the reduced strip to be stored for several days in a heated building without rusting and to be annealed without the formation of stains and smudges. Should the material pass these tests, then it was judged to be worthy of a larger scale trial on a production mill. During the experimental rolling, any unusual characteristics were noted, but this test was not used as a means of evaluating the rolling characteristics of the oil. Of the materials tested, only three have passed this preliminary test, giving evidence of its usefulness.

Testing on the single stand mill proceeded as follows: a solution of the recommended concentration was made up and poured in the storage reservoir. In order to insure complete mixing, the solution was circulated through the mill for at least one half hour. When it was judged to be thoroughly mixed, a concentration analysis was made and repeated at intervals during the actual rolling. Four to six coils selected from larger production orders were then reduced to specified gage.

At the completion of the rolling, half of the coils were sent to the annealing department and the other half were stored. Immediately after annealing, the coils were rewound at a very slow speed and carefully inspected for stains, smudges or any other unusual characteristics. After a suitable time, usually two weeks, the remaining coils were taken from storage and also rewound to facilitate inspection for rusting. Earlier in the program, coils were stored for longer periods, but it soon became evident that, if rusting was going to occur under normal conditions, two weeks was ample.

During the entire testing program, we not only asked but insisted that at least one representative from the supplier be present during every phase of the rolling and inspection. In this way, there was no need for interpretation of the results.

After successful completion of the first stage, arrangements were immediately made to start the second step. At this time, we acquainted the supplier with the details of the five-stand mill and agreed with him on procedures. As previously described, this mill is ideally suited for such a testing program as it is equipped with two complete recirculating systems. Prior to any test, we thoroughly cleaned the mill and tanks. After cleaning, the selected tank was charged with a 6000-gal solution of the trial oil. The remaining tank, filled with our regular solution, was left untouched. Afterwards regular rolling procedures were followed on the day shift so that all interested parties could be in attendance. From then on, all evaluations of the trial oil were made in comparison to normal operating practices. By this we mean that the crews were instructed to make every effort to maintain normal operating speeds and reductions. Numerical readings of mill loads, delivery speeds, oil concentrations and strip temperature were recorded. In addition, visual inspection of surface and shape of the reduced strip were made. Our next step was to stop, drain the mill and switch over to the second tank. Then, using coils from the same order, rolling continued with our regular oil solution. This procedure was sometimes followed three

or four times, after which we then discussed with the supplier the results of the test.

SOLUBLE ROLLING OIL CONTROL

Proper usage of the rolling solution is equally as important as its initial selection, particularly in regard to maintenance of the correct emulsion, pH of the emulsion and cleanliness of the emulsion. In our case, the metallurgical department makes daily checks on the oil content and pH and makes weekly analyses of the iron content of the rolling solution in all units.

The per cent concentration of the rolling solution is analyzed by placing a representative sample of the coolant into a Babcock bottle, adding a mixture of salt and acid, heating to about 180 F for 30 min, and finally, centrifuging to obtain a clear cut separation. The oil content is then measured and reported as a per cent of volume. We attempt to maintain a 4 to 6 per cent solution in all mills except the sendzimir mill, which is kept at 8 to 10 per cent. A freshly made emulsion of the rolling solution can be easily broken down, but as the solution is used and becomes contaminated with tramp oil and iron, the separation becomes increasingly more difficult, and the above procedure is required to obtain a good separation in every case.

A daily pH test is made on each rolling solution using a glass electrode pH meter. We attempt to maintain pH above 7.4 so that no difficulties with emulsion separation due to acid conditions will be encountered. The pH values normally obtained in service range from 8.0 to 9.0. The water used for makeup and to replace drag-out loss is slightly alkaline, so that we normally have no difficulty with excessively acid solution.

The iron content of the solution in each mill is checked weekly and the results are graphed as a monthly average. The test consists of dissolving the suspended iron particles in the sample of solution and then determining the iron content colorimetrically. The metallic iron contaminant in the rolling solution is so finely divided that much of it passes through our finest filter paper, and for that reason, as well as the excessive length of time required for such filtration, we adopted the method of dissolving and making a chemical determination of the iron content.

If we were asked to name the characteristics contributing most to good cold rolling practice, maintenance of cleanliness of rolling solution would be high on the list. The dirt present on cold rolled strip consists of the residues produced in previous operations as well as that produced in the cold rolling operation. Residues from pickling consist chiefly of iron and iron salts as well as other residues from the scale, such as manganese, phosphorous, etc. Overpickling may result in excessive smut.

During cold reduction, very finely divided metallic iron is ground from the surface of the strip. Some of this iron is flushed from the strip by the coolant, and some is carried out on the strip. Conditions which tend to increase rolling friction, such as a rough hot rolled strip surface, use of matte rolls, etc., will increase the amount of iron smut produced. When fresh, the roll coolant acts as a cleansing agent on the strip as well as a lubricant, but when recirculated over a period of time, the solution becomes contaminated, particularly with metallic iron and tramp oils, and will contribute to dirty condition of the strip. Leaded oil contamination is particularly bad since it tends to "plate out" on the strip.

Regardless of the source of dirt in the rolling solution, it tends to accumulate and collect on the strip and on the work rolls, particularly near the edge of the strip. It not only leaves a smut on the steel, but the abrasive action of the contaminant adversely affects the roll finish with consequent deterioration of the surface finish on the strip. It is necessary then to either change solution regularly before the contamination builds up, or to find a method to constantly clean the solution. The first alternative is quite expensive. In our case, solutions had to be changed about every four weeks, along with a thorough cleaning of the mill and solution tanks. We, therefore, undertook a research program to discover the best means of maintaining cleanliness of our rolling solution.

After investigation of all of the various filtering de-

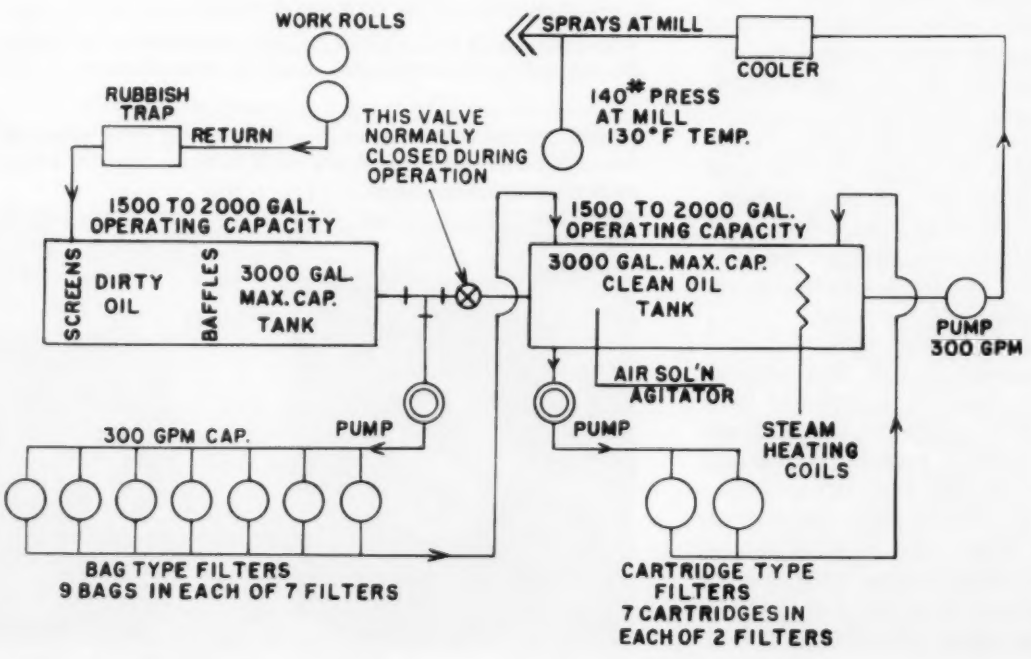


Figure 6 — The full flow filtration system is used to clean oil for the sendzimir mill.

Figure 7 — Centrifuge is used for the reversing mill and 4-stand tandem mill.

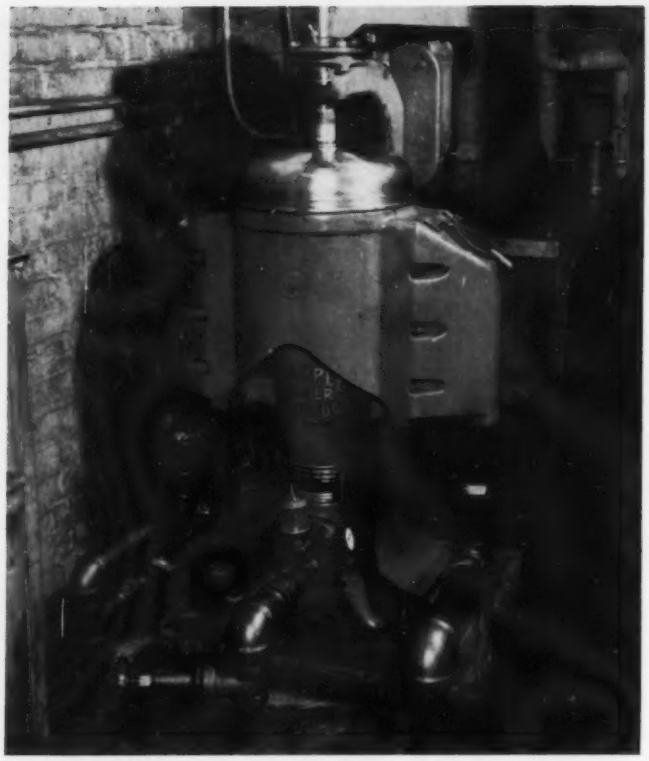


Figure 8 — Note color of solution which is apparently as clean as fresh emulsion.

vices, we concluded that separation of the contaminants in rolling solution could best be done by centrifuging. We first installed a 600 gal per hr centrifuge at the reversing mill on a by-pass system, and the results exceeded all expectations. The solution was used for approximately two years with no apparent breakdown or deterioration, and during that period, it was not necessary to clean the mill or the tanks. During that period, additions of rolling oil were made only for make-up, evaporation and drag-out. At the time of this writing, the practical life of a rolling solution is not known, but it is our belief that the oil itself does not decompose under rolling. If effective filtration is used, the coolant can run indefinitely. It was our thought that a tank skimmer was also necessary to periodically remove tramp oil from the surface of the solution, and accordingly, such a unit was installed. We soon discovered, however, that the skimmer was unnecessary.

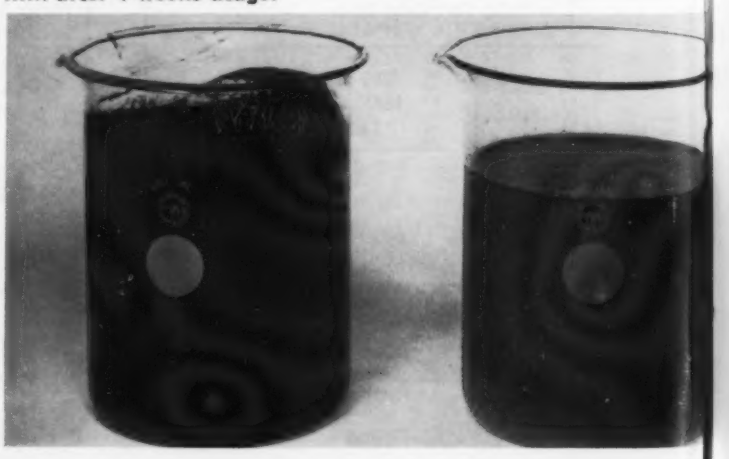
The next centrifuge installation was made on the four-stand tandem mill, with the same results that were observed on the reversing mill. In this instance, however, a 1200-gal per hr unit was installed. Results have been so spectacularly favorable that, at the time of this writing, a similar unit has been ordered for use at the five-stand tandem mill.

Filtration of the solution at the sendzimir mill (Figure 6) is achieved through a full flow system, utilizing two 3000-gal tanks. Solution is returned from the mill through a rubbish trap and thence to a 3000-gal settling tank. From the settling tank it is pumped through a 300-gpm capacity set of bag type filters consisting of seven filters arranged in parallel, each one of which contains nine flannel filter bags. The solution is then pumped into a 3000-gal capacity clean oil tank, thence to a cooler and back to the mill at about 140-psi pressure and 130 F temperature. Further cleaning is accomplished by by-passing solution from the clean oil tank through two cartridge type filters containing seven filter cartridges in each. The filter bags in the primary filter must be renewed every six months, and solution remains relatively clean indefinitely.

Figures 7 and 8 show the centrifuges installed in the reversing mill and the four-stand tandem mill. It can be seen from the color of the solution that it is apparently as clean as a fresh emulsion even after many months of use. Figure 9 shows a comparison of solution taken from the reversing mill after 24 months of use, as opposed to a sample taken from the five-stand mill after only four weeks of use. The difference is obvious.

We believe that magnetic iron contamination in rolling solution should be kept below 0.1 per cent by weight. Figures 10 and 11 indicate the iron content in the solutions used in the reversing mill, the two tandem mills,

Figure 9 — Solution taken from reversing mill after 24 months contrasted markedly with sample from 5-stand mill after 4-weeks usage.



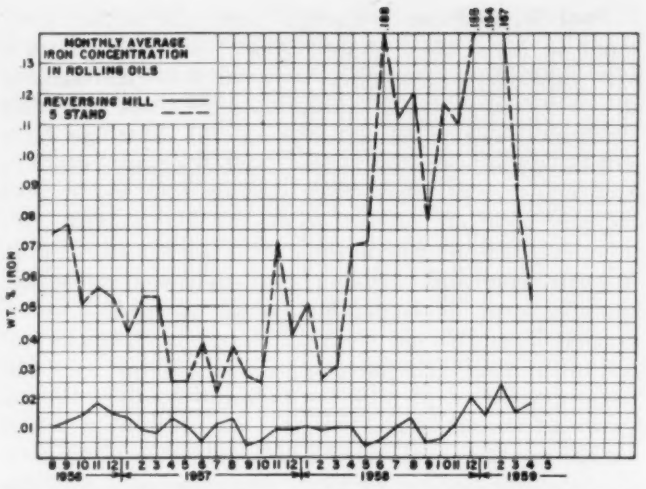


Figure 10 — Magnetic iron contamination should be kept below 0.1 per cent by weight.

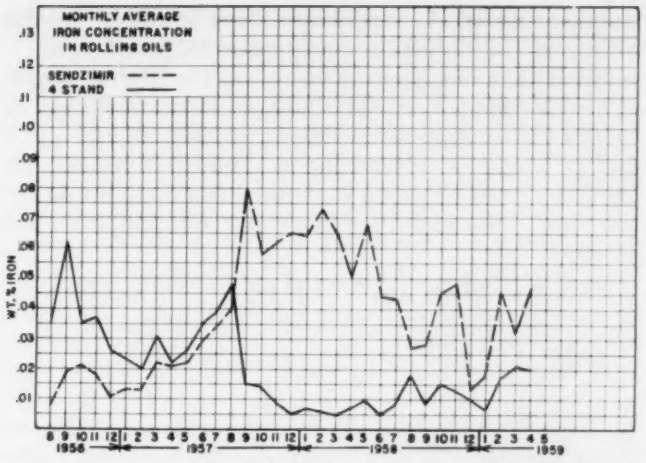


Figure 11 — In the past two years more contamination is shown in oil from sendzimir mill than from 4-stand mill.

and the sendzimir mill. It is obvious that filtration by centrifuging has kept the iron contamination in the reversing mill and the four-stand tandem mill close to zero even though the solutions are never changed, whereas there is substantial contamination in the five-stand mill in the face of frequent changing.

The initial selection of a rolling oil is quite important, and due consideration must be given to all factors involved. Lubricity, wettability, detergency, freedom from staining and corrosion are all factors which must be weighed in this consideration. Equally important, however, is the subsequent use of the coolant, and care must be exercised to maintain the solution in its proper concentration, and free from contamination. Proper attention to all of these factors will pay dividends through better quality and decreased costs.

Discussion

PRESENTED BY

J. J. DALTON, General Superintendent, Cuyahoga Works, American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio

PAUL W. COFFMAN, Assistant General Superintendent, Riverdale Plant, Acme Steel Co., Chicago, Ill.

G. R. MARKLE, Sheet Mill Superintendent, Indiana Harbor Works, Youngstown Sheet and Tube Co., East Chicago, Ind.

F. L. OTTO, General Superintendent, Detroit Steel Corp., Detroit, Mich.

C. E. PRITCHARD, General Superintendent of Mills, Alan Wood Steel Co., Conshohocken, Pa.

W. H. MANDY, The Texaco Co., Pittsburgh, Pa.

J. J. Dalton: It is recognized that the question of finish of strip is very difficult to evaluate in a quantitative manner. Perhaps we could get Mr. Coffman to make a few remarks comparing the finish secured on the five-stand mill with those secured on the four-stand tandem.

Of particular interest to me is to note that the soluble oil concentration range that Mr. Coffman considered desirable on all mills is from four to six per cent. This is very similar to the range that we aim at in connection with our reversing mill.

I believe a point worth discussing is the matter of the effect of the leaded oil. Perhaps you could discuss the probable source of the lead in that oil and the degree of contamination which this lead has in the control of your production.

Paul W. Coffman: We agree that the surface finish of strip is difficult to evaluate in a quantitative manner. We have experimented with the use of a profilometer on both our work rolls and the finished strip in an attempt to deliver a uniform and consistent surface finish to our customers. However, we are unwilling to state that this is an exact science or is without problems.

Our surface finish obtained on our five-stand tandem mill is generally better than that produced on our four-stand tandem mill. This, of course, is largely due to the added reduction which we can obtain on our five-stand tandem mill. Our total reductions range from 75 to 90 per cent on our five-stand, as compared with 50 to 65 per cent on our four-stand.

As mentioned in my paper, leaded oils or greases which may enter the solution have a tendency to plate out on the strip and leave a dirty surface. These may come from some of the lubricating oils or greases used on the housing or in connection with the screwdown drives. We caution our maintenance organization to exercise unusual care in order to prevent excessive drippage or over-lubrication. Recent developments in the field of application of lubricants for enclosed gears and bearings offer opportunity for prevention of contamination as mentioned above.

G. R. Markle: Apparently Acme has an ideal setup for testing rolling oils. We are not this fortunate. Most of us have one or two high-speed mills and cannot afford the quality risk or the possible loss of tonnage to experiment with different rolling oils.

In his paper, Mr. Coffman stressed the importance of cleanliness of the solution. We have our No. 1 stand blocked off and run solution on the remaining stands of our mill. We find this does a very good job of keeping pickler carry-over from getting into the solution. Although we have not run the extensive tests that Mr. Coffman has in his plant, we feel that the percentage of contaminants is fairly small.

One question that I would like to have Mr. Coffman

comment on is whether or not there is any noticeable difference in reduction on a new solution versus a solution that has been in operation for several weeks.

Also, in his paper, Mr. Coffman mentioned that he carries his solution temperature between 80 and 130 F and it would be interesting to know his reasons for holding to 130 F, which to us sounds a little bit on the low side. Normally, we carry our solution from 130 to 150 F.

Paul W. Coffman: We find no particular advantage in using a new solution over a used solution. Actually, with the particular oil we are using at this time, we find that after eight to sixteen hours of usage on a new solution that we have better control of the mill, particularly, reduction between the stands and general shape through the mill. Likewise, we have not found any advantage in controlling mill shape by an increase in solution concentration. However, this may be a peculiarity of the particular brand that we are using.

We have tried carrying our solution temperature higher than the 80 to 130 F that we use and were unable to discover any advantage in doing so. Actually, because of the various products which we produce, we often speak of some of our mills as a job shop operation. By that, I mean that we often have orders, even on our five-stand mill, that may consist of one, two or three coils per order, and with the production rate of 3000 fpm, we do not have a need to carry our solution at a higher temperature. I recognize the advantage that you indicate of carrying the solution at a higher temperature, and I am sure that it has an application when you have orders of greater tonnage than we have available.

F. L. Otto: The problem of soluble oil rolling solutions is interesting to all cold rolled strip producers and to most cold rolled sheet producers.

Probably one of the most important items in the paper is the section on methods of evaluation. In this section, it is explained that the preliminary tests are run on one mill with two separate rolling solution reservoirs. The new solution is put in one and the standard rolling solution is put in the other reservoir. A number of coils from a large production order are rolled using the new solution, and then the mill is cleaned. Then an equal number of coils from the same production order are rolled using the standard solution. Both groups of coils are then followed through the various steps of the test. This is important because it eliminated variables, variables in hot band surface, pickling, annealing and atmospheric conditions. These variables might be considerable if coils rolled with the new solution were compared with coils rolled with the standard solution during a previous week or a following week.

Another item of interest is the use of rolling solution to lubricate roller bearings. I know that Acme Steel Co. has been doing this for a considerable period of time successfully. I would caution our friends, however, not to try this practice unless they are certain that their rolling solution is clean.

We agree with Mr. Coffman that one of the most important requisites in producing a good surface on the finished product is a clean rolling solution. Mr. Coffman and Acme Steel Co. have proved this by their finished product.

Paul W. Coffman: I might add as a further comment to Mr. Otto's remarks that we have had some very interesting experiences over the years through the use of rolling solutions to lubricate the work roll roller bearings. The manufacturers of the bearings have exhibited considerable interest, and of course, we have had many visitations from various mill users. We believe that our results speak for themselves. We have had a similar experience with our sendzimir mill. We consulted with various operators, as well as the mill manufacturer before conducting an experiment to ascertain if soluble oil solutions could be used on our sendzimir mill. The answers indicated that it would be necessary for us to take the risk and conduct the experiment on our own. Our mill was initially designed for the use of mineral oil as a roll coolant and lubricant. Fortunately, our experiment was successful and has paid considerable dividends. I am sure that everyone knows how difficult it is to remove mineral oil from the surface of the finished strip prior to annealing or other finishing operations.

C. E. Pritchard: Being limited to a 12¼ x 33 x 32-in. four-stand tandem mill only, all evaluation testing of roll oil solutions has been directed to the equivalency of a full scale rolling test, much in the manner described in Mr. Coffman's paper regarding the five-stand mill.

In our case an arbitrary figure of approximately 500 tons of coil product is believed to be consistent with sufficient product mix to cover our normal order book expectancy as to gage and grade on any test run.

A prerequisite for the roll oil to be tested in our mill is that it will offer enough flexibility to permit blending with a 100 SSU viscosity at 100 F mineral oil for precoat; readily emulsify and be stable in solution with water in the range of 2 to 6 per cent emulsions for normal rolling practice on the tandem mill and also when mixed with water on a 1 to 1½ ratio, the latter being supplied at stands 2 and 3 as a supplemental application during heavy drafting periods.

We concur with the statement that maintenance of cleanliness of a rolling solution is of extreme importance. In order to provide such needed control, it has been our practice to skim periodically and dump the solution charge at predetermined intervals based upon past experiences. It was found that this interval would vary appreciably due to the type of product rolled and roll preparation employed. We have recently incorporated a series of magnetic type filters which to date indicate the possibility of extending the service life of the rolling solution to a marked degree.

Of equal importance to stability and cleanliness of the solution is that of controlled carry-over of solution by the sheet being processed. Usage of air wipes are found to be very effective in obtaining proper distribution of the rolling solution over the full width of the sheet, while aiding in the sweeping of metallic and carbonaceous material toward the outer edges of the sheet during the rolling cycle. In this manner it has been possible to provide a cleaner finished product and minimize the amount of makeup oil required to maintain the desired solution concentration level.

Wipe tests are conducted at the tandem mill rewind reel, temper mill entry and exit and on the slitter lines to ascertain the degree of surface cleanliness de-

veloped by the various rolling practices employed during the test. An adjunct to this spot check procedure is that of taking a sample sheet from a given coil and after washing the surface with a solvent, we quantitatively determine the percentage of foreign contaminant present, a low figure on this type of evaluation would be in the range of 8 to 10 mg. per sq ft.

Typical operational data taken from a series of recent rolling solution tests are offered as follows:

pH range during use....	8.5 to 6.2 per cent
Ash content during use	0.04 to 0.09 per cent
Iron content during use	0.03 to 0.075 per cent (calculated as Fe_2O_3)
Concentration (oil) during use.....	2.5 to 1.8 per cent
Tramp oil contamination.....	1.0 to 5.0 per cent
Surface tension solution during use.....	35.2 to 35.4 dynes per cm

Samples are also taken from the magnetic filter effluent at periodic intervals. A typical test based upon our limited experience to date with this type of equipment would be as follows:

Iron content.....	0.54 to 0.65 per cent (calculated as Fe_2O_3)
Water content.....	93 per cent
Tramp oil.....	6 per cent

As mill operators we are constantly striving to improve our quality and cost levels and as such the review of Mr. Coffman's paper poses the question of service life expectancy of the rolling solution. Would Mr. Coffman tell whether or not an economic study has been made on his operations to determine the amount of make-up oil added on his reversing mill and four-stand mill where a centrifuge was in service as opposed to the five-stand mill where no centrifuge was employed and the solution charge was dumped at given intervals? We would also like to know whether a cellarman is employed to cover the operation of the centrifuge, and if so, the number of turns he is in attendance.

Paul W. Coffman: We too employ air wipes to remove as much of the solution from the strip surface as possible prior to coiling. Undoubtedly, our practice is very similar.

We apply the solution to the strip as well as the work roll surface. We spray solution at both the entry and delivery side of each stand except for the delivery side of No. 5 stand.

We likewise use the wipe test (with white paper) to determine the amount of dirt left on the strip surface. We have also conducted some experiments with cellophane tape and are presently attempting to provide a numerical evaluation of the residue or color of the tape as observed under a microscope or reflectoscope using a measured light density. So far, our results are not sufficiently consistent to provide a basis for a standard. However, we are continuing to experiment and hope to develop a usable standard as a result of this investigation.

Initially, when we were investigating the various methods of cleaning the solution, we ran tests with various suppliers to determine which method would be satisfactory for us. Our experiments indicated that a centrifuge would meet our requirements. We are happy to report that we recovered our capital investment in the first nine months. Obviously, our management looks favorably upon such an investment.

The addition of the centrifuge did not require an increase in hourly personnel.

W. H. Mandy: I would like to ask Mr. Coffman just how much stress he puts on the temperatures. I believe you mentioned, in one case, a 100 F degrees, and in another case, 120 F. You also mentioned 130 F. I was just wondering whether it is a factor in your rolling operation and how you arrive at the various rolling temperatures as being most suitable.

Paul W. Coffman: As you recall, our various cold reduction facilities operate at different finishing speeds, and each one has an individual capacity with respect to total cold reduction. We have adjusted the temperature of our rolling solution to fit each mill. Our solution temperature has been adjusted in each case to suit the rolling characteristics of each piece of equipment, and at the same time, to meet our quality control standards. The temperature is automatically controlled in each case. We have found that this control of temperature permits us to assure ourselves of better shape and quality from each mill. At the same time, it is compatible with our production demands and does not prevent us meeting our tonnage quotas. ▲

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Electronic Maintenance Training At Allegheny

Allegheny Ludlum's organization of an electronic maintenance group has assured successful utilization of its automatic control program

HOW important is maintenance to the success of a program designed to introduce automatic controls and data-logging systems into a steel mill? Who should perform this maintenance? Where are these maintenance people to be found? Is it going to be necessary to train them? If so, how should they be trained?

These were some of the many questions being asked when the electro-mechanisms dept. was organized at Allegheny Ludlum's Brackenridge plant in the fall of 1955. The months preceding the organization of this department had seen the recognition on the part of management of the quality and production improvements possible through the incorporation of automatic control and data-logging systems into their engineering plans. It was evident to the members of this new department and others involved that maintenance was indeed a prime factor in the success of such a program and that the procurement and training of maintenance personnel was one of the first steps to be considered.

Actually, electronic maintenance training at the Brackenridge plant had begun in 1954 as a part of the instrument repair apprenticeship program. This training was in the form of correspondence lessons aimed at the maintenance of existing equipment. This electronic equipment consisted of such things as furnace temperature controllers, welding controls and some radiation and contact measuring systems.

It soon became apparent that the existing electronic maintenance training program would fall short of the requirements dictated by this new field of automatic control and data-logging. Such subjects as digital techniques, measuring and control systems, servo-systems and computers were not offered in a form suitable to needs by existing electronic training sources. Equipment and component manufacturers did offer training on their specific equipment, but this too was not suitable to needs for several reasons. The prerequisites for these training programs usually demanded previous training in these new subjects. The programs were necessarily restricted to the manufacturer's equipment and presented to the student a narrow knowledge of the field. The expense of sending and keeping men at the schools was high.

At meetings of the Brackenridge maintenance, training and electro-mechanisms depts., a program for electronic maintenance organization and training was agreed upon. The following points were included in the program:

1. The electronic maintenance group would constitute a new and separate group within the maintenance dept.
2. The job of electronic repairman would be established with the industrial engineering dept. submitting a job description and classification to the union for negotiation.
3. Six men would be assigned to the group to participate in a 13-week electronic training program. At the end of this training, they would be assigned as class C electronic repairmen. They would be entitled to ask for and receive a test for advancement to the "B" rate after 1040 hr and subsequently advance to the class "A" electronic repairmen rate.
4. The applications for the job would be solicited by plant wide bidding.
5. The applicants for the first group would be chosen by a battery of tests to determine their acheivement, aptitude, ability and interest in the field of electronics. Qualified men would be assigned to the job with preference being given based on electrical maintenance unit seniority, maintenance dept. seniority and plant seniority in that order.
6. The electro-mechanisms and training depts. would train an electronic training supervisor to set up the program.
7. All necessary training equipment would be purchased and a training room prepared.
8. It would be recommended to the union that the joint apprenticeship committee meet to develop an apprenticeship program for future expansion of the maintenance group.

The training dept. began immediately to search for suitable training equipment. It was found that a well known supplier of electronic equipment for the armed services had, as a part of its field engineering services, a training program using training equipment well suited to our needs. This equipment consisted of both lecture-demonstration and laboratory equipment covering practically all of the standard electronic circuits.

The lecture-demonstration equipment consists of individual panels each representing a typical operating electronic circuit. The circuit diagrams are silk screened onto the panels with the plug-in electronic components mounted beside their symbols. The actual wiring is done on the back of the panel. The use of plug-in components makes it easy to demonstrate the effect of changed component values or defective components on the circuit operation. The panels can be modified quickly to demonstrate off-standard circuits.

The panels can be used individually or in combinations to demonstrate complete electronic equipments. As many as eight panels can be mounted on a rack which is part of a demonstration console having a shelf for test equipment and enclosed portion for panel storage. The laboratory equipment consists of individual chassis, each wired with an electronic circuit identical to a lecture-demonstration panel. The components are mounted on terminal boards that are removable by knurled nuts. These chassis are mounted on racks which can accept up to 24 chassis. The use of these panels and chassis fits very well into the training concept of breaking complex systems down into simplified blocks. Logical trouble-shooting procedures that naturally follow such a concept were developed and stressed throughout the training.

Until this time, the training equipment manufacturer had never sold the equipment to private industry but used it only in training programs sold to the armed services or industry supplying the armed services. Allegheny Ludlum negotiated for the purchase of this equipment and arranged with the manufacturer for the person chosen as electronics instructor to visit the manufacturer's plant to become familiar with the methods of using the equipment in classroom training.

A training room was prepared and equipped with four work benches with necessary tool drawers and electrical outlets. A large blackboard was installed. This and the lecture-demonstration console were arranged so that the students could view both at the same time. All necessary hand and power tools were ordered.

A study of available text material was made to attempt to find a text suitable to the program's needs. This proved to be fruitless in that no one text seemed to be designed for our particular needs. For the mathematics portion of the course, a text was chosen which is in use in many of the electronic technical schools. For the basic electricity and electronics sections, armed services manuals were purchased for this first group. The laboratory workbook supplied with the training equipment was most suitable for laboratory sessions.

Although maintenance training would normally be a function of the plant training dept., it was felt that the person chosen to organize and present the training should, in this case, be a member of the electromechanisms dept. His prime responsibility would be training, but he would actively participate in the engineering projects of the department. In this way, he would be able to keep up with the rapidly advancing program and choose the training program content in such a way as to stress that material most suitable for effective maintenance of the equipment being installed. The plant training dept. provided the technical assistance in the organization of the training materials and methods.

Notices were posted throughout the plant in April, 1957, announcing the new position of electronic repairman, and inviting all those with previous electronic experience or training to bid for the job. Approximately 65 men responded to these notices and testing began. The tests consisted of standard psychological tests to determine the man's ability, aptitude and interest in electronics. In co-operation with the training dept., a test was designed to determine the applicant's achievement in the field of electronics. The majority of the questions on this test were of the multiple choice, completion or matching type so that an objective weighting and grading system could be established.

Six men were chosen from the group using the electronic achievement test results as the primary and the other tests as secondary factors. All necessary negotiations were completed with the union and the men went on the job in September, 1957.

It is interesting to note the qualifications of the six men chosen and the wide variety in the previous positions held by these men. Four of the six were amateur radio operators. One had recently become interested in radio and enjoyed it as a hobby. Only one had any formal training, having attended a local electronics technical school for about one year. The position held by these men were machinist, electrical maintenance foreman, electrician, reheat furnace stocker, press helper and repair helper.

Since the training and experience qualifications held by the men varied, it was decided to start them all at the same point in the training program and bring them quickly to a common level, slowing down whenever necessary to cover a particular subject not thoroughly understood by everyone. Since a program with full time training was planned, it was decided to cover all the mathematics first, then proceed into basic electricity and subsequently into electronics. No shop practices section was planned as it had been assumed that all had had experience with the care and use of tools common to the trade.

As to the training on a specific piece of equipment, it was planned that, as soon as the basic subjects necessary to understand the equipment operation were covered, a short theoretical and on-the-job program be set up.

The training program itself began on the day that the men started on the job. It was soon found that the original full time training schedule could not be followed due to the pressing need for men to install and maintain equipment going into operation. The original plan of advancing the men from a temporary training rate to class "C" journeymen 90 days after entering the program was followed. The actual 520 hr of training was completed by the time the men became eligible for advancement to class "B".

In June, 1958, they were tested and all advanced to

Ludlum Steel Corp.

by J. C. HAUBE,
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class B. This test consisted of five parts. The first part was the same electronic achievement test previously given to the men when applying for the job. Comparison of these test results to the original results showed significant improvement in all cases. The other four parts of the test consisted of four practical electronic circuits built up with the laboratory training chassis. Defective parts were placed into the circuits to simulate actual maintenance problems. The men were required to find the troubles and repair and adjust the circuits for optimum operation within a time limit. Setting this limit simulated the pressure that they would expect to be under in an actual maintenance job.

It should be mentioned here that two men did not reach this point in the program. One dropped out voluntarily. Being an electrician before entering the program, he was accustomed to heavy power equipment and found it difficult to do the extra-fine work required in the construction and installation of our electronic equipment. In the case of the second man, it was mutually agreed that he return to his previous job. His mathematical capabilities were such that, even with extra effort on his part and help from the instructor, he was unable to keep up with the rest of the group. One of these men was replaced by an apprentice from the instrument repair group who was taking an instrument repair correspondence course. This training allowed him to fit into the training schedule without any back-tracking for his benefit.

The first 100 hr of the course consisted of the mathematics considered necessary for further electrical and electronic training. Algebra was covered from fundamentals to the solution of simultaneous linear equations. The section on Trigonometry covered the solution of right triangles and fundamentals of plane vector analysis. During this section, the men expressed an interest in the slide rule, so about 16 hr were alloted to the fundamental uses of this tool. This time was found to be well spent, as use of the slide rule in later sections of the course saved considerable time. Slide rule training will now be a permanent section of the course.

This mathematics was followed by 140 hr of basic electricity. From this point in the course, laboratory experiments were scheduled as often as possible to give the men practical diagnostic and trouble-shooting experience.

The remaining 280 hr of the basic 520-hr course were spent on vacuum tube fundamentals, circuits and some of the specific equipment in use.

It should be made clear that this 520-hr course is considered to be only the basic portion of this training program. Much ground remains to be covered and it is anticipated that this will be a continuing program as dictated by future needs. Scheduled for near future classes are sections on transistors, static and rotating magnetic amplifiers, computer fundamentals and regulating and position control systems. Training equipment has already been ordered for the transistor and static switching sections. Training is currently taking place on the maintenance of automatic typewriters and printers being used in data-logging systems being installed or already in operation.

On August 1, 1958, one of the men in the group was promoted to foreman and a new electronic repair shop was built and furnished under his direction. As a part of his supervisory duties, he is performing on-the-job training to supplement the formal training.

The four journeymen in the group were advanced to class "A" in December, 1958. It was agreed at this time that this advancement did not mean an end to the training but that it would continue as required by the advancement of the art.

The end of last year saw a need for additional men in the maintenance group. An apprenticeship program was agreed upon by the joint union-company apprenticeship committee and notices were posted for applicants in October. Approximately 115 men applied for the job and 45 were tested for the apprenticeship. Only men who had records of company employment were tested. The testing procedure was the same as the first group except that the electronic achievement test was not included. Using the test scores of the first group of repairmen as standards, six men qualified for the position. Four of these six were chosen and began the program in June, 1959.

In setting up the training program for these apprentices, certain modifications are being introduced based on experience gained in the original training program. The mathematics textbook is going to be retained. The search for a textbook covering the basic electricity and electronics units has never ended and, as yet, no single text suitable to needs has been found. We have therefore decided to prepare our own text material for the course. Permission has been obtained from various publishers and manufacturers to use selected sections of their texts and maintenance manuals along with our own material in the preparation of these textbooks.

More laboratory sessions are planned in the apprenticeship program. The trouble-shooting practice obtained by the placement of defective components into the laboratory chassis is going to be stressed more so than before. More planning must be put into the organization of laboratory experiments so as to minimize the possibility of ambiguous experimental results.

The mathematics unit will be scheduled simultaneously with the shop practices and basic electricity units rather than as a separate unit. In this way, the mathematics necessary to understand a particular section of basic electricity will be scheduled immediately before that section and be fresh in the student's mind.

The apprenticeship program is intended to include 1000 hr of classroom and laboratory training over the next four years. The following units are to be included in this program:

1. *Shop Practices*—Lecture and laboratory sessions covering the care and use of hand and power tools, construction, installation, maintenance procedures and safety. Length—approximately 60 hr.

2. *Mathematics*—Lecture sessions covering algebra, trigonometry and plane vector analysis. Length—100 hr to be distributed with shop practices and basic electricity units.

3. *Basic Electricity*—Lecture and laboratory sessions covering electron theory fundamentals, motors and generators, a-c and d-c circuits. Length—about 140 hr.

4. *Basic Electronics*—Lecture and laboratory ses-

sions covering theory of vacuum tubes and vacuum tube circuits. Length—280 hr.

5. *Solid State Electronics*—Lecture and laboratory sessions covering theory and circuits of transistors and magnetic amplifiers, fundamentals of static switching, binary systems and fundamentals of digital computers. Length—120 hr.

6. *Fundamentals of Electrical Control Systems*—Lecture and laboratory sessions covering voltage and current regulators, speed, tension and position control systems. Length—60 hr.

7. *Specific Equipment*—Lecture and laboratory sessions on specific equipment designed or installed by electro-mechanisms dept. Length—240 hr. This unit will be scheduled as dictated by the installation of the equipment.

The plans made by the Brackenridge electro-mechanisms, training and maintenance depts. in 1955 have been realized. The maintenance group now consists of a foreman, four journeymen and four apprentices. The electronic training room has been equipped with all the needed equipment for the basic portion of the training program. The text material is being prepared and additional training equipment ordered for the advanced portion of the training program.

In December, 1958, the electro-mechanisms dept. was reorganized as a department of the corporation general engineering division. We will now be working jointly with the corporation training dept. in making our training materials and methods available to all plants of Allegheny Ludlum.

No attempt is being made to set up a single standard training program that can be used in all plants. Many factors will need to be considered in organizing the individual plant training programs. The quantity and installation schedule of equipment will determine the starting date and speed of a training program. The programs must meet conditions dictated by the local labor agreements and existing training setups. The course content will necessarily be modified to fit the particular type of equipment installed.

One thing can be said that will be true of any plant training program, as soon as our help is requested by a plant, work will begin immediately on the organization of the training program. It is felt that the installation of the equipment should be handled by the men who will be maintaining it and some training must precede this installation.

Our experience in electronic maintenance training at Allegheny Lundlum has led us to believe that we have successfully answered the questions asked at the outset of our program. Let us repeat those questions:

1. How important is maintenance to the success of a program designed to introduce automatic controls and data-logging systems into a steel mill?

The equipment reliability that is assured by a well trained and organized maintenance group has confirmed our original position that good maintenance is a prime factor to the success of such a program.

2. Who should perform this maintenance?

It was decided from the start that our engineering talent should not be burdened by maintenance problems. The training and organization of the maintenance group has not only freed our engineers from maintenance, but we have found that the maintenance group has been able to assist the engineers in minor design problems.

The training and experience gained by the electronic maintenance group has created a pool of potential talent for the engineering staff.

The engineering of future projects has been greatly aided by the existence of a feedback path from the maintenance group. Many worthwhile suggestions for equipment modifications and simplification have been incorporated leading to increased equipment reliability.

3. Where are these maintenance people to be found?

Experience has shown us that the talent necessary to create an effective maintenance group is available within the plant and can be found by suitable testing methods.

4. Is it going to be necessary to train them?

Although many training organizations are striving to provide training programs to suit the needs of industry, it is difficult for them to adequately cover the wide range of necessary subjects needed by all industries. For this reason, we have found it necessary to organize our own training program.

5. How should the maintenance personnel be trained?

This paper has shown how our training program has been organized and carried out. We feel that we have a great deal more to learn and a considerable amount of work remains to be done.

It is recognized that each individual situation has its own particular problems and solutions in this field of electronic maintenance training. Our own efforts in the field have been encouraging. It is this encouragement that has prompted us to offer this paper relating our experiences for the benefit of those who plan to initiate training programs of their own.

Discussion

PRESENTED BY

R. T. WINTERRINGER,
Superintendent, Electrical Dept.,
Republic Steel Corp., Chicago, Ill.

J. D. O'ROARK, Assistant Manager,
Dept. of Services and Maintenance, Electrical,
Weirton Steel Co.,
Div. of National Steel Corp.,
Weirton, W. Va.

HOWARD T. LENTZ,
Training Co-ordinator,
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R. J. BEESWY, Superintendent,
Electrical Dept., Indiana Harbor Works,
Inland Steel Co., East Chicago, Ind.

F. J. HRABAK Supervisor of Training,
Reliance Electric & Engineering Co.,
Cleveland, Ohio

H. W. DORSET,
Assistant Superintendent,
Electrical Dept., Bethlehem Steel Co.,
Sparrows Point, Md.

R. T. Winterringer: Mr. Haube's paper is the summation of important management planning, decision

and action, recognizing an important and absolutely necessary phase of electrical maintenance. This is a particular type of maintenance which even the graduate electrical engineer, unless he has completed electronic courses as a part of his curriculum, or has obtained experience or training cannot thoroughly accomplish. The successful, experienced maintenance electricians who have in the past scoffed at the idea of replacing radio tubes or transistors in a steel plant are also inadequate without previous electronic training or experience.

In the South Chicago plant of the Republic Steel Corp., we were mercifully gradually forced into selecting men, several years ago, to maintain equipment of a more or less experimental nature. Following the installation of our seamless tube mill in 1952, we were immediately plagued with x-ray equipment, seam depth indicators and farrow testers which were, in the beginning, maintained by men from the laboratories who also collected performance data. It is perfectly obvious that this outside maintenance by these specialists, could not become permanent.

We were fortunate in our selection of three amateur radio operators who spent several hours each day with the laboratory men in on-the-job training. Two of these men, approximately one year ago, completed the FCC examination for the maintenance and adjustment of a high frequency voice communication system recently installed on our transportation equipment, such as locomotives, diesel cranes, overhead cranes, and straddle trucks. The recent installation of electronic regulators on our high-speed shear rectifiers and the programming of screwdown control have added to their burdens.

Some of these installations have brought definite action by our company on the only possible positive course of action, which has been well planned and placed in effect by Allegheny Ludlum Steel Corp. The selection of a so-called suitable electronic repair shop, and the necessary maintenance tools and equipment is not quite enough. We are aware that electronic courses and a new direction of final training must be added to our present apprentice program, which should include the necessary training equipment. Some of the controls planned for various operations of Republic's present general expansion, will make the fulfillment of such a program necessary.

J. D. O'Roark: I would like to pose the following questions:

1. Why did not Allegheny Ludlum use some of the personnel in electronic maintenance group in existence as of 1954, for the extended training considered necessary for the higher level of maintenance coverage? Are we correct in assuming none of this early group qualified under the tests set up by which the first group of six was chosen?

2. You stated that due to pressing need of personnel to install new equipment, the training program was interrupted from time to time. Was time spent in this manner credited in any way to the training program?

3. Is there any labor relation difficulty resulting from electronic repairmen installing and wiring new equipment? Sometimes "electrical construction" wiremen consider new equipment installations their field of work.

4. What job class applies to the four steps leading to and including class A?

5. Is the foreman of the electronic repair group on a salary basis?

6. Is there a possibility that the present job class of the class A electronic repairman will have to be raised since he will spend additional training time as required by future higher level maintenance requirements?

7. Did management ever consider establishing this maintenance service on an "electronic technician," monthly salary basis, so as to have free choice of personnel?

Allegheny Ludlum is to be congratulated for recognizing their need and taking full and effective measures to adequately cover same. The requirement is so well defined and so vitally important that any halfway measures would be a serious mistake.

It is gratifying and encouraging when the labor union recognizes such needs and assumes a co-operative and constructive attitude instead of opposition and insistence that "No changes can be made." We are in accord that this need be drawn from among existing employees who obviously must be closely screened as evidenced by the small number accepted from the large number of applicants. We feel the "electronic achievement test" given the applicant is very important since it indicates the interest and previous level of accomplishment in electronics by the applicant.

The "four-item laboratory test" given when advancing to class B is excellent.

It is the writer's opinion that the apprentice training program is well formulated. Availability of qualified personnel to teach the several units of instruction is a major consideration in the success and progress of the project. Again we commend Allegheny Ludlum in providing adequate laboratory space and up-to-date laboratory equipment. All too many times such programs are undertaken with only passive approval by management with little or inadequate space or equipment provided.

Allegheny Ludlum's program should pay progressively higher dividends each additional year of its existence.

The practice of Weirton Steel Co. on this subject is as follows: our earlier requirements for electronic maintenance started in 1943 on the high frequency induction reflow on several continuous electro-plating tin lines, and on hole detection and electronic sheet counting on associated shearing lines.

Over a period of years we have added railroad radio, Police dept. and crane-to-floor communication systems, and the conventional communication systems on hot strip mills, cold roll tandem mills, continuous picklers, cleaning lines, continuous annealing lines, etc., serviced by "communications repairmen and helpers."

Four years ago, due to the increased number of x-ray gages, river boat radar, the advent of the use of TV on many rolling operations, beta-ray gages, strip width gages, linear measuring devices, electronic scales, electronic regulating devices, and many others, the necessary maintenance and repair was reorganized under a general electronic supervisor, with an electronic repair foreman in each of three major departments. The number of electronic maintenance personnel has

grown from five in 1943 to 51 in 1959.

The electronic repair requirement is covered by an electronic trainee who must pass an aptitude test. He enters at class 6 then progresses one job class every six months, assuming that he makes satisfactory progress, to job class 12.

The trainee then, or at an earlier date is privileged to take an examination for assistant electronic repairman, job class 13. After attaining this level for six months he can then take the examination for electronic repairman, job class 17.

For those employees interested in improving their education along these lines, we have an outside industrial education and training course, both day and night classes, in mathematics, basic and advanced a-c and d-c electricity, blueprint reading, basic and advanced electronics, etc.

On the job training is provided through the instruction of the foreman, both in the electronic repair shop as well as in the field. Our three electronic repair shops are equipped with the latest commercially available tools and test equipment.

At present, service and maintenance dept management is examining the best approach adapted to our present organization for advanced training for the same level now concerning Allegheny Ludlum.

We feel that of our present total of 51 electronic maintenance personnel with an average ten years experience, we can select five or six capable of moving on to the higher level.

It should be evident from Allegheny Ludlum's approach, as well as that of Weirton Steel's, that such a program must be well organized, well equipped, well managed, and it will adequately take care of the future requirements.

Howard T. Lentz: I shall try to answer Mr. O'Roark's questions.

1. We felt that our instrument repairmen would be able to absorb this small amount of work as we could see it then. We decided that they were to be trained. These men in the instrument repair group had been selected pretty much in the same manner we used to select the electronic repairmen at a later date. These instrument repairmen and any other employees in the plant had the opportunity to bid for this job as did everyone else. At that time the job description had not been completely prepared and an agreement had not been reached with the union as to the ultimate job class. As a result, since the training apparently was going to be to some degree parallel with the instrument repair group, the employees in this group did not file an application. We did have one or two filed and subsequently one of them did enter into the electronic repair group.

When selecting the employees in the instrument repair group, we had not used an electronic achievement test in our test battery. Since we wanted to start our electronic training program at least two or three steps up the ladder instead of beginning back where two and two are four, we hoped to find people who had some electronic background and basic knowledge that would permit us to do so. Fortunately the local union agreed with us. The primary requisite, was the successful passing by the applicant of the electronic achievement test. The second requirement, of course, was a high level of mental ability, aptitude and then personality, in that order.

2. As Mr. Haube's paper pointed out, the first plan was a 90-day, full time training program where the employees spent four hours in the classroom and four hours in the laboratory. Progress was being made rather rapidly on some of the equipment designed by our electro-mechanisms group and it was ready to be installed. It became necessary for us to utilize some of the time we had originally planned as training for construction and installation. As a result, although the related instruction still amounted to 520 hr, it was extended over a period of nine months. During this nine months, the schedule ran on the order of three days in the classroom and two days on the installation of equipment.

3. Some questions arose in connection with labor relations on installing new equipment. They were handled through our labor relations department and cleared up. We have not had to face them again. It was recognized that the electronic repairmen did have a responsibility for a tie-in into the operating, and regulating mill equipment, and it was understood that this is probably the point at which the electronic repairmen's work ceased.

4. In our electronic repairman apprenticeship, in 5½ years he progresses from job class 2, to job class 18. The progress is one job class every six months, for the first six apprenticeship periods and two job classes for the last two apprenticeship periods. He finishes at job class 10. This is a period of four years' training. If he has successfully completed his apprenticeship, he is promoted to job class 14, or class C journeyman. At the end of a six month period he is promoted to class B journeyman at job class 16 and again at the end of the last six month period to class A journeyman or job class 18. At the end of 5½ years he is a full-fledged journeyman.

5. The foreman of the electronic repair group is on a salary basis.

6. We try as everybody else in this industry to prepare job descriptions that anticipate further upgrading of job classes. In this case we think our job descriptions cover future responsibilities.

7. To put electronic technicians on a monthly salary is a little difficult since there is quite a separation between salaried employees and hourly employees. One of the difficulties or questions we would have to face in this connection is whether or not these technicians would be permitted to pick up a screwdriver and use it. As an alternative we felt we could locate within the hourly ranks of the employees of our plant people who were capable of absorbing the training that we wanted them to have, and that they would have inherent ability, aptitude and interest to this job. We decided that we should carry this out as a production and maintenance job rather than to extract it from the bargaining unit. We also thought this would minimize any labor relations problems we might have.

R. J. Beeswy: We at Inland Steel have used a different approach in an attempt to solve this training problem. Our thinking is to train the mill electrical personnel to handle all electrical and electronic devices. To meet this end we have in our new mills established an electrical technician classification as the top job in the sequence. In these areas, as well as in the re-

mainder of the plant, a centralized electronic repair group is utilized to back up the mill personnel.

We would be very interested in learning more about the types of training materials used, the manufacturer of these materials and your training methods. As you mentioned in your paper, suitable texts are not available and good training aids and equipment are almost nonexistent. We also would be interested in all of the factors to be considered when choosing the men to receive this training, and especially, any particular qualities which your experience has shown to be desirable in a candidate.

F. J. Hrabak: Over the past ten years, the use of regulating equipment has increased in the areas of strip propulsion and process variable control almost twenty-fold. This has been brought about by demands for more precise control of existing systems, increases in processing speeds, and the desire to eliminate the human element from the art of steelmaking. A typical example is a galvanizing line; currently, being engineered utilizing twenty regulators, while the first such line engineered by our company had only five regulators.

Our company has established a facility called "Industry Maintenance School" which provides the function of magnetic and electronic maintenance training for its customers. This maintenance training can be obtained in two ways: (1) the customer's man can be sent to the school in Cleveland for a comprehensive, intensive one-week course, or (2) in the event that many people are to be trained, or the people to be trained are unable to travel, it is possible to have the school brought to the user.

Just what kind of training is supplied by these sessions? Starting in 1954, we conducted maintenance school classes and accrued knowledge as to what subject matter had to be taught. It soon became evident that the major emphasis had to be placed on basic electricity and an introduction to magnetics and electronics. In order to maintain magnetic and electronic equipment, it is necessary to teach an understanding of the circuitry and guide the students in developing techniques for trouble-shooting equipment.

The first two days of a five-day school are spent on basics which can apply to any electrical drive. The first few days include information on basics of d-c generators and d-c motors, evolving into the variable voltage system of control. Along with this is supplied a short, concise introduction to electronic tubes by lecture and movie techniques. The material presented is only that which is pertinent, from a maintenance standpoint, to trouble-shoot circuitry. No attempt is made to bring out fine points of reactance and electronic circuitry which would be of interest to a design engineer.

Also in this basic section is included regulator theory, but not from a mathematical standpoint. This section brings in the concepts of reference and feedback, showing how corrective action takes place and how a constant output is obtained. On the third day, we get into specific regulator panels made by our company, but again the techniques for trouble-shooting can be applied to anyone's equipment.

We feel that in learning our equipment, our customers are more competent to work on electrical equipment in their plant. When the student attends class at the home office school, he has an opportunity to spend one and one-half days actually trouble-shooting the regulator panels in our laboratory facilities. We have approximately $100,000 worth of equipment in our laboratory which can accommodate forty people at a time without crowding. Emphasis is placed on trouble-shooting, logical thinking and thorough understanding of the circuitry involved. Even though we know full well that in the students normal work at the plant, they will be looking for only one trouble in the panels, we complicate matters by putting six, eight and ten problems in one piece of equipment. This eliminates guess work trouble-shooting. Since we realize that the majority of troubles can be found by the "see-touch-and-smell" technique, we make sure that the troubles we put in cannot be identified in that manner.

Since its inception in 1954, our industry maintenance school, in both its home office and extension course activities, has had the opportunity to train about 3500 people. Approximately a year and a half ago, the demand for our training at the customer's plant site increased and we made available what we refer to as the "Maintenance School Extension Course." Here we go into the customer's plant, spend anywhere from two days to two weeks, depending upon the equipment, complexity and the degree of training of their people. The course is tailored to their specific requirements. We supply all manuals, texts and teachers. During the last year, some 25 to 30 plants requested and were given this course.

Demand for this type of service has enabled us to add additional personnel to the training dept. and, our schedule is filled through February of 1960, as of now.

We feel that even though our program is restricted to our own equipment, the fact that we emphasize and teach the basics involved in understanding anyone's equipment provides a broad base for future courses, either by other manufacturers or by the user himself.

We feel that our function of training the customer does not replace the in-plant training supplied by the customer's training department. We do feel, however, that we fulfill a definite need for additional information on our equipment. Our school can supply specialized knowledge of check-points and other trouble-shooting procedures obtained by long experience with the equipment. The customer's cost of the training can be returned very quickly by the reduction in downtime in his plant.

We sincerely wish that all of our customers had a maintenance training program as comprehensive as the one described here this morning by Allegheny Ludlum Steel Corp.

H. W. Dorset: As the author has recognized, modern electronic devices and systems require a group of well trained specialists who will necessarily have to be given continued training throughout the course of their employment to keep in step with the rapid progress in the field of electronics. We have followed a policy similar to that of Allegheny Ludlum in carefully selecting potential electronics personnel from within the plant with a background in electronics, either from the armed services or night schooling, as a basis for further on-the-job training and classes with our particular equipment.

We do not have as complete and comprehensive a program as described by the author, and at present we do not plan such a program. A separate department for maintenance of all electronic equipment might be helpful from the standpoint of being able to concentrate on the electronic equipment, but there certainly would be a loss of necessary co-ordination when the equipment is used as a part of the control system of a mill or finishing line. We do have a small group whose time is devoted entirely to the maintenance of the various public address systems, television, radio and electronic scales, etc., but have nothing to do with automatic control, data logging, radiation or non-contact gaging systems.

The need for a group of engineers with electronic knowledge still exists, however, I doubt that the average maintenance man needs the equivalent training. We have certainly not carried out a program of company training in mathematics and other subjects not related to our maintenance mission.

It appears that Allegheny Ludlum has classified the job of electronics repairman as a craft, and this I feel is desirable as arguments over promotion are avoided.

I have three questions to ask Mr. Haube:

1. Does the electronics group to which he refers also maintain and install communications equipment and are they trained along this line toward becoming FCC licensed personnel for radio work?

2. When your text is completed, do you expect to publish it or otherwise make it available to others in the industry who may be interested?

3. What job rate classification does your class A electronic repairman enjoy?

Howard T. Lentz: (1) Our electronic repairmen handle the maintenance of closed circuit TV systems and radio frequency signaling devices (automatic door openers, etc.). They do not handle public address systems or radio. They are not trained toward FCC licensing. (2) Due to commitments made relative to copyrighted material, our manuals will not be available for distribution. (3) The class A electronic repairman is classified at job class 18. ▲

Available Translations

As a service to readers of the *Iron and Steel Engineer* a list of transactions from foreign articles is being printed intermittently. Articles selected for this listing will be those of primary interest to the American Steel plant operator. The papers may be obtained from the British Iron and Steel Industry Translation Service, The Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W. 1, England. All correspondence concerning price, ordering, and so forth should be directed to that address.

1306 MULLER, H. G., and W. LUEG: "Conclusions Drawn from Rolling Tests in a Four-stand Cold Rolling Mill for Wide Strip," *Stahl u. Eisen*, 1959, Mar. 19, pp. 325–331. Variations in strip thickness, roll force and strip tension in the individual stands on altering the rolling speed. Theoretical explanation of variations in thickness by altering the coefficient of friction, displacing the roll necks in the backup roll bearings, altering the tension and resetting the rolls. Thoughts on the distribution of the roll force between the individual stands. Effect of the layout of the drives on the utilization of final rolling speed for different rolling schedules. Effect of variations of certain characteristics and of motor load on automatic compensation of variations in the thickness of the hot rolled strip. Conclusions concerning the possibilities and limitations of controlling the final strip thickness on high-speed multistand cold mills. (Author's summary.)

1122 HASIMOTO, H. A.: "Aerodynamic Design of the Open-hearth Furnace." III—Functions of Lower Furnace, *Tetsu-to-Hagane*, 1957, Feb., pp. 117–121. Flow patterns were studied on two- and three-dimensional furnace models. In the slag pocket there is a main curving flow in the upper part and three-dimensional vortices below. The fantail does not act as a flow equalizer, but can be improved to give more even flows by sloping the roof downwards to the checker chamber. The flow into the checker chamber tends to pass through the farther side; this can be rectified by fitting deflectors or using double-path chambers. (Abstract J.I.S.I., 1958, Feb., p. 181.)

1313 HUSER, K. H.: "Critical Consideration of Mechanization and Automation in Steel Production," *Stahl u. Eisen*, 1959, Jan. 22, pp. 64–73. Total steel production must be increased, and working hours per ton of product reduced; U. S. and West German figures are compared. To profit by mechanization, and to reduce the number employed on finishing and despatch, the number of types of product must be restricted, as in the motor car industry. Economies in power consumption, for example by reducing friction losses, can lead to substantial savings; so can systematic study of requirements at the design stage of machinery, pre-planning of transport and accurate measurement of problems and costs at all stages. Examples are given of many parts of a steelworks which need critical investigation.

1329 ZIDEK, M., and B. GLATZ: "Hot Rolling of Thick Steel Plate Clad on One Side with Stainless Steel," *Hutnicke Listy*, 1958, Aug., pp. 679–786. Survey of production of thick plate clad on one side with stainless steels. Analysis of deformation and heat treatment of clad steels. Technology of rolling sheet clad with the steels AKVS and AKIW; relation between the degree of reduction of the base metal and the cladding. Calculations of the dimensions of the cladding and slabs used for rolling clad steel. Conclusions. (Author's summary.)

Is The Fault Always Electrical?

Modern equipment system components must be considered as a unit . . . . for most efficient operation and maintenance, a well-trained staff is needed which understands electrical, mechanical and hydraulic components and in addition has a working knowledge of the characteristics of the process.

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THE personnel charged with mechanical or hydraulic maintenance would, I am sure, insist that the title of discussion be called "Are the faults always mechanical or hydraulic?" This discussion is not intended as an attempt to "whitewash" any group but merely to point out that many problems arising in the more complex and high-speed machines of today's trend toward automation may appear to have an electrical cause but actually may be mechanical in nature, or vice versa. It will not ridicule anyone in the obvious location of some troubles since it is very easy to be trapped into chasing the trouble in the wrong direction, nor will it put us up as experts. It is hard to tell the differences between electrical and mechanical troubles. In many cases, electrical trouble may even be corrected mechanically or mechanical trouble corrected electrically with the result that sometimes unnecessary compromises are made.

With the advent of new and complex automatic processes, the task of pinpointing trouble in the complete system has become more difficult. With a simple control scheme handling a single motor, it was relatively easy to check the location of a fault. Now with the combination of a hundred electrical motors closely tied to a single system and coupled to hydraulic, pneumatic and mechanical motions, any one of which may interact with the others, greater care must be taken to insure that the correction is applied at the source of the trouble.

Maintenance and preventive maintenance policies must be geared to the study of not one machine or device but to the process as a whole. Traditional service methods may have to be reviewed in terms of questioning each phase of a process, with greater care being taken to insure that corrective measures be applied to the proper motor or device rather than the device which appears to be malfunctioning.

Making any complex system economically feasible and acceptable should start with the design. This is one instance where a pessimist in the organization is a decided asset. Looking for trouble in advance and recognizing that there will be downtime caused by strip breakage, bearing troubles and hydraulic failure and then trying to design around possible trouble gives the user a decided advantage.

We have long ago all recognized the need for electrical fuses, the addition of mechanical "fuses" will be found to be as worthwhile. If faulty operation is liable to break the strip, it is better to try to force it to break in an easily accessible place. In a pickling line, cleaning line or annealing line, wrong tensions, loop failure, weak welds or rough edges are going to cause the strip to break. Most modern annealing lines for example have now installed knife blade type protection well ahead of hard to rethread places which will cause the strip to break at a spot where the downtime may be minutes instead of hours.

Strip breakage in an annealing furnace requires cutting the heat, removing covers top and bottom, locating the strip ends, rethreading by dropping chains down between hot rolls, welding the strip, replacing the covers, bringing the furnace back up to temperature, and in most cases, purging for as long as two hours before the line can be brought up to operating speed. On the other hand, causing the strip to break at some easily accessible spot ahead of the furnace, even in the storage tower, means that it is merely necessary to rethread the tower and reweld out in the open, and providing the line has not been stopped for more than ten minutes or so, return immediately to operating speed.

An adequate strip break indicator, an annunciator to pinpoint the break, coupled with liberal observation

windows and lights in the furnace will help to hasten rethreading and return to operating speeds.

The minimum number of compromises made in the design of an integrated line means minimum downtime. The right equipment properly applied is usually paid for in the first few months of operation. Oiltight, dusttight or watertight equipment, where required may have a higher first cost but may reduce downtime considerably. Planned cut out, and removal of unused or obsolete equipment as soon as possible eases the problems of maintenance personnel who must be able to decide at a moment's notice which equipment is still usable.

While accessories should be mounted securely, care should be taken to insure that replacement is relatively easy.

During the design of new equipment, it is, of course, possible to add all of the modern features and technological advances. However, it is also helpful in reducing downtime to remember that much equipment too valuable and usable to scrap may be rejuvenated by adding modern regulators, fault indicating systems, new type bearings and lubrication systems and new hydraulic and pneumatic traps and filters. The advantage of such modernization is, of course, first reflected in smoother operation and reduced electrical and mechanical stresses, and therefore reduced maintenance requirements. Reduced wear and tear on the equipment prolongs the life and, therefore, helps to postpone the long downtime caused when the entire line must be replaced.

The modern steel mill is profitably using regulating equipment to obtain better quality, higher speeds and greater tonnage with minimum manpower and downtime. Better regulating equipment is all the more important on older, costly equipment which is still very serviceable but subjected to high maintenance, both, electrical and mechanical caused by high stresses due to lack of regulation.

Better regulation can increase speed of response while at the same time offering better protection to the equipment. It can help to correct slow fields on old design motors and generators by high amplification, while preventing overshoot under normal operating conditions.

By adding a regulator with current limit control, maximum rates of acceleration and deceleration were obtained on a 5000-hp blooming mill while actually reducing the mechanical stress because of the stepless speed changes obtained. Consequently, many years of additional mechanical life was given to a very costly piece of equipment by an electrical change. It is conceivable also that mechanical changes might be made to ease the job of an electrical piece of equipment.

However, at this time we are more concerned with locating the source of trouble so that we may more effectively determine whether the fault is electrical or mechanical.

Money spent for fault indicators or circuit monitors is usually rapidly recovered. Memory type annunciators or circuit monitors pinpoint the trouble and on complex lines may be the actual differences which justifies the complex line as compared to several simpler lines.

Here again the proper fault indicator must be chosen to fit the application. Devices which have auxiliary contacts or are not subject to momentary outages may be monitored in many ways. Certain devices such as field loss relays and overload relays, however, which may not have extra contacts, may not open far enough to close a fault indicator or are subject to momentary outages require a special type of circuit monitor. This requires a memory and also the ability to monitor a circuit which may have the control voltage appear across the contact as soon as the device opens.

Great care must be taken to insure that the annunciator circuit does not interfere with the correct operation of the control, especially when monitoring a circuit with a number of contacts in series.

The circuit monitor should be self-policing in that a failure of the circuit monitor itself should not cause a failure of the control being monitored but should at the same time indicate a fault in the monitoring device.

Portable circuit monitors are available which may be used when the cost of continuously monitoring may be deemed too high.

The circuit monitor is indispensable during startup, to easily detect which fan, blower, lubrication pump or limit switch or any of the other auxiliary equipment has not been started. But its particular advantage comes in its ability to determine which device has been subjected to a momentary outage.

A memory type fault indicator prevented an improper correction from being made on a line where a check of the ammeter indicated that a line was being stopped by the tripping of a pinch roll motor overload relay. An examination of the circuit monitor, however, showed that the payoff reel field loss relay was opening momentarily. However, it was not opening far enough to drop out the undervoltage relay. The payoff reel regulator was then checked and found to be allowing the payoff reel motor field to be weakened momentarily to an unnecessarily low value. This caused the payoff reel motor to lose torque thereby shifting the load to the pinch roll. Raising the calibration of the pinch roll motor overload relay may have corrected the stopping of the line but at great danger to the pinch roll motor. The correct solution was a minor adjustment of the payoff reel tension regulator.

Assuming that all faults which may conceivably be checked by the circuit monitor have been eliminated, it is still possible to check the wrong device at the time a malfunction is observed.

The danger of checking the wrong device may be best illustrated by an example which occurred during the setup of a line. A photo-electric loop control went out of range and filled the looping pit. Upon investigation, it was found that the control would no longer go through its operating range as the steel was manually moved in the path of the lights. While checking out the control, a sweeper standing nearby mentioned that when he looked into the pit from a door at the bottom of the pit, he turned on the maintenance light and the steel from the loop came tumbling down on top of him. The temporary solution consisted of unscrewing the bulb from the loop pit maintenance light. This light had been installed in a position allowing it to shine into the photocell units and even though the regular photocell light source was blocked by the loop, an indication of an empty looping pit was given. Up

to that night, the light had never been turned on. The maintenance light was later moved to a spot where it could not interfere with proper operation. While most modern photo loop controls are far less sensitive to extraneous lights, some care should be taken to insure that welding flashes, ceiling lights and windows are not allowed to give a false signal to the control. While the control may be setup to compensate for extraneous light, this light may periodically change because it is blocked by the movement of a crane or by differences between day and night light intensities. Correct mounting is most times no more costly and may allow that little extra range sometimes needed to correct an unusual operating condition.

While talking about loop controls, it might be well to mention a common cause of loop control hunting in cases of long storage type loops. The swinging of the loop may sometimes make the loop control appear to be hunting. The addition of drag magnets properly located will steady the loop and improve operation.

The foregoing electrical problems mentioned were corrected mechanically, one by adding a drag magnet, the other, by unscrewing a light bulb—but are these problems electrical or mechanical?

The preventive maintenance program should include marking the correct setting of adjustable resistors and obtaining an accurate set of readings of meters under various operating conditions to give a few check points in case trouble suddenly occurs. Many times adjustments are made to various resistors which may correct trouble which is really caused by some outside force. Some mills take pictures of meters under various operating conditions which allow comparisons to be made in a bank of meters at the time trouble develops.

Friction of course, is the greatest variable. Changes in temperature, lubrication, condition of bearings, dirt, or alinement may vary the load as much as five to one. This variation cannot be accurately predicted, but a sudden rise in motor current may be the tip-off allowing a correction to be made before costly repairs are required. Setting of bearing supports causing misalinement and bad tracking may sometimes be determined if a few operating point voltages and currents have been recorded.

The operation of a scalebreaker into a pickling tank through a magnetic pickup type loop control and into an exit pinch roll was not performing satisfactorily. At times the loop became tight and at other times it was dragging on the bottom of the tank. The first consideration was given to the loop control itself. After thorough checking, the loop control was exonerated. It was then decided that the exit pinch roll was slipping but the trouble was not located until a sometimes clogged lubrication line on the scalebreaker finally clogged long enough to allow a bearing to freeze completely, locating immediately and dramatically the true source of the trouble. An electrical correction could probably have been made but an accurate current reading on the scalebreaker might have prevented it—but is the trouble electrical, mechanical or hydraulic?

Hunting of a motor may occur from various sources. With the advent of regulators, most hunting trouble responsibility has been shifted from the series field of the motor to the regulator. A reversed series field could always be easily spotted and easily corrected. With a regulator, the tendency is to suspect the regulator and because considerable correction can be obtained by use of anti-hunt windings, the hunting condition sometimes disappears. Sometimes, however, this is done at great sacrifice to the gain and, therefore, the accuracy of the regulator.

As an example, a mechanical error, which together with an incorrect electrical adjustment plagued on otherwise very efficient and intelligent maintenance department for almost five years. Oil was being sprayed on a strip of steel ahead of a pinch roll which was speed regulated. It had been noted that the speed regulator hunted considerably. A great deal of time was spent trying to "anti-hunt" the regulator and while some success was obtained under steady state conditions, the regulator was far too slow in response during speed changes.

The motor field current was eventually checked and found to be only about ten per cent of its rated and expected value. The gear ratio was then checked and found to be wrong. The difference in speed had been made up by weakening the field (evidently a "temporary" adjustment). Operating at weakened field, the motor had so little torque that the coating of oil would build-up ahead of the roll unit the surface tension would break down and allow the bubble to squeeze through the pinch roll. Each time this happened the regulator hunted. When the proper gear ratio was installed, the regulator and the motor were able to operate in their design ranges and almost all "anti-hunt" correction was removed. With the proper gain restored to the regulator, no further trouble was experienced during speed changes.

When regulating tension, slippage is a common cause of trouble. The danger of slippage is that it is rarely constant over the entire speed range. On a 2000-fpm recoiling line many attempts were made to correct the tension regulator of a wind-up reel. The line would periodically run away and at 2000 fpm the results were sometimes spectacular. A two-motor bridle was the pacer for the line and checking carefully for slippage it was found that with the bridle running at 1500 fpm the steel ran anywhere from 1200 to 1800 fpm depending on whether the payoff or the wind-up reel had the greatest tension. However, when the bridle speed was dropped to 1400 fpm the slippage dropped to 50 fpm. At 1300 fpm there was no detectable difference between the roll and the steel.

Differential type tachometers may be used to accurately check slippage, but the method of slippage correction on a two or three-bridle motor depends very much on the mechanical problems. Balancing the loads by means of the shunt or series field of the motors is not always the correct solution, since field strength is not proportioned over the entire range. A mechanical change may have to be made in the amount of wrap or the addition of snubber rolls to make sure that the proper amount of wrap is always obtained. This is particularly true at high speed where windage enters the picture, sometimes abruptly.

In the case of a speed regulator, a warped roll on the motor driving the tachometer generator used as feedback may cause the line generator or exciter to "hunt." This in turn might cause a tension regulator on the

same system to "hunt." Both the line exciter and the tension regulator may be "anti-hunted" and the trouble apparently corrected.

As an example a pinch roll motor supplied by its own generator, in turn fed by a line exciter, using a tachometer generator on the pinch roll as a feedback, was found to be "hunting" considerably. Changing the line exciter regulator from a speed regulator to a voltage regulator indicated that the system was stable until the feedback was added. An examination of the tachometer generator on the pinch roll disclosed that not only was the shaft warped but the coupling had also loosened. Correction of the coupling (mechanically) corrected the apparently faulty operation of the regulators. The correct solution, therefore, is to correct the warped roll, or tight bearing, or loose coupling, or loose chains, or slipping bridle, or even hunting of the motor ahead or behind the suspect. The regulators may then be adjusted to have just the right amount of "anti-hunt" and negative feedback (if any) to insure the greatest accuracy.

Since most maintenance people agree, as we have said before, the greatest problem in servicing equipment is locating the source of the trouble, every possible aid should be given to make it easy to spot trouble before it starts. While most mills periodically check resistance to ground to help ward off possible breakdown of insulation in motors, generators and controllers, little effort has been applied to the field of noise and vibration. Noise and vibration in many cases have been considered as merely annoying. Checking and charting balance and noise levels periodically may allow a minor correction to be made before serious damage is done to not only the motor or generator in question but also to adjacent bearings and supports. New electronic methods of balancing allow the trouble to be more accurately located. Proper location of the fault will prevent hours spent trying to balance a generator when in reality it might be a bent shaft on the opposite side of the motor-generator set.

In one case many hours were spent trying to adjust a clutch on a screwdown on a blooming mill. After a time it was noted that one of the motors was noisier than the other. Balancing of the motor showed a slightly bent shaft which had evidently occurred during a minor earthquake. Straightening of the shaft allowed an easy adjustment of the clutch.

With increasing speed also, comes the further problem of trying to see what is happening at high speeds. More and more companies are using the high speed camera to more closely view trouble spots in the line. In some cases, it is possible to use a home movie type camera to determine that the contour of the steel going over a snubber roll or through a gate on a shear line is interfering with proper operation. On high speed lines it is not feasible to open the gates feeding reject lines any farther than necessary. With a high speed movie camera, it is possible to determine that the leading edge of the strip may be leaving the belt because of windage just ahead of the gate. The addition of magnets may allow better control of the strip near the trouble spots.

So far in this discussion little has been said about hydraulic equipment. However, many a solenoid has been blamed for the fact that a certain device has been erratic or failed to operate when the culprit has been water or dirt in the line and even in one case, where a welded "T" connection had been made without drilling out the hole at the point where the "T" had been formed.

Tracking is the worst offender and troublemaker. Who can say when bad tracking is caused by poor tension control, poor steel, wrong roll alinement, wrong roll shape, improper quenching or cooling of the material. Electrically, it must be recognized that while a wide range of tension can be tolerated during running conditions, there can be no instantaneous variations during acceleration and deceleration. Once started by a little slack, bad tracking usually persists until a speed change is made. However, since buckles and wrinkles are usually caused by the same forces used to correct bad tracking, that is higher tension, and proper rolls, and in the case of hot strip, proper cooling, some thought should be given to correct only as much as required.

With prime emphasis placed on exact location of troubles, it might be pointed out that the maintenance personnel deserve all the help they can get. Circuit monitoring by means of memory type fault indicators or annunciators, up-to-date diagrams, instruction books and operating charts and adequate meters including recording meters and performance data help to keep the electrical controllers operating properly.

Proper mounting, maintenance and preventive maintenance plans, electronic balancing and high speed cameras, lubrication and ready access to lubrication charts and data can help keep machinery, motors and generators at peak efficiency.

Clean traps and filters, periodic checks for line leaks, and oil level indicators, all aid in correct and trouble-free operation of hydraulic or pneumatic installations.

However since the chain is no stronger than its weakest link, the entire system must be considered as a unit. To tie all phases together, there is no satisfactory substitute for a well trained staff which understands not only the electrical, mechanical and hydraulic components, but also has a working knowledge of the particular characteristics and problems of the process.

The more we strive to make troubleshooting a question of location of the exact source, the easier it is to make planned corrections rather than emergency breakdown projects which at best are "temporary" compromises which many times become permanent.

Discussion

PRESENTED BY

H. H. ANGEL, Electrical Engineer, Construction Engineering Dept., Bethlehem Steel Co., Bethlehem, Pa.

R. C. SUTTLE, Application Engineer, Reliance Electric & Engineering Co., Cleveland, Ohio

H. H. Angel: Mention is made that an acceptable system should start with design, and the entire system must be considered as a unit. There is no satisfactory substitute for a well trained staff which understands not only the electrical, mechanical and hydraulic components, but also has a working knowledge of the

particular characteristics and problems of the process. The writer heartily subscribes to this theory. Past experience becomes a guide in determining what should go into a design to make the operation and maintenance of the process meet its expected performance. However, when the process is entirely new, then "headaches" in the operation may be expected until the "bugs" are ironed out.

In the past, some steel mill operating personnel were fearful of the use of complicated electrical equipment involving regulators, electronics, etc., since it was felt that maintenance men would not be able to keep the equipment running without expected long delays. The writer believes these fears have pretty well subsided because maintenance personnel, including engineers, are being properly trained. These types of automatic processes are now well established. The author shows that the use of annunciators, fault indicators and circuiting monitors are proving helpful in reducing downtime. Certainly well organized preventive maintenance will also reduce delays.

The author points out several other items worthy of mentioning which are helpful in time of trouble. Among these are the taking of pictures of meters under various operating conditions and the accessibility of charts showing meter readings. These can be used for comparisons during these conditions.

R. C. Suttle: Such a controversial subject, will be received with mixed emotions by the various departments of all organizations associated with the industry. Since the electrical equipment is supplying the muscle, either directly or indirectly, for the integrated electromechanical power application for either the process function or strip propulsion, it is only logical that the electrical equipment is the first looked to when trouble occurs. As producers of electrical equipment, we have long accepted this concept.

Recently, we have had occasion to review the logged downtime of a high-speed electrolytic tinning line utilizing fifteen regulators for the strip propulsion and four regulators for process variables. Over this one year period, 60 per cent of the downtime was attributed to the mechanical equipment and 40 per cent to the electrical equipment. Of the 40 per cent attributed to the electrical equipment, less than 1 per cent was specifically accountable to the regulating equipment.

After a processing line or mill has been placed into successful operation on all products, downtime that develops usually can be classified into two areas: they are, intermittent and trend-type.

The author mentions the usual methods of determining intermittent-type failures. Usually, the use of cycle or circuit monitoring, fault-finders and recording instrumentation will locate the areas where the trouble originates. The next problem is to find out the "where" and the "why."

On a recent foil mill installation that had been in operation for several years, our service department was asked to investigate an intermittent problem that was being experienced. The trouble was traced down to the drop in water pressure on a water-cooled device on the mill. The pressure switch was checked and found to be satisfactory. The next procedure was to check all electrical elements, wiring and connections. All were found to be in order. The next procedure was to check the plant water pressure with a recording instrument. This also was found to remain within the limits of satisfactory operation. The next procedure was visual observation. The cause was finally located. The actual cause was, at this particular time of day, one of the operating personnel used a sanitary facility that was not used frequently. The flushing of this remote unit caused the pressure to drop in the coolant supply, thus causing the chain of events.

This classic example of a problem in intermittent downtime is typical. All such problems are not as easily tracked down. It took all the methods of fault detection to track down this nonelectrical problem.

The second type of problem is that associated with a trend. This is usually of such a nature that it has been developing over an extended period of time. This is a little bit more difficult to track down. The best method of tracking down such a problem is to have available either recording readings of the various elements of the drive or process at the initial satisfactory start-up, or to have a recording reading of the performance of the various critical drive elements. If the latter is not practical, a logging of meter readings will do the job. If this type of information is available, the trouble usually can be isolated. If it is not available, a complete review must be made of operational problems, and the human element comes into play.

As an example of this type of problem, we recently had an installation outside of the steel industry on which we were requested to review the overloading of one of the elements of the drive which had an abnormally high overload. This section of the machine was similar in nature to a set of pinch rolls. After this machine had been in operation for six months, a frantic request was received to review the electrical drive equipment to account for the abnormally high overload.

A log of load readings was reviewed, and showed that the load had developed over a period of time. Since the machine was in continuous operation, it was not possible to shut the machine down for a complete check. All of the circuit elements were visually checked, and the regulating system was observed. From all data taken, it was concluded that the electrical equipment was performing satisfactorily. This report was made with the suggestion that the trouble should be sought elsewhere. After a two-day period the main bearings on one side of the machine froze. In assembling the machine, the bearings had been assembled backwards, and there was no external lubricant flowing from the central pressure system which was monitored.

The examples cited above are everyday occurrences. It takes the combined efforts of all interested groups, whether they be mechanical, operational or electrical, to track down the cause and effect a rapid solution, thus keeping the downtime to a minimum. Without this co-operative effort, the problem will never be fully recognized, nor the solution a lasting one. ▲

Are you annoyed by having someone borrow your magazine when you want it? Get him to join the AISE!

Republic's Bar Mill of Tomorrow

by D. E. WEAVER,
Superintendent, Finishing Mills
and H. E. BERG,
Chief Engineer, Chicago District
Republic Steel Corp.,
Chicago, Ill.

. . . . Republic's new bar mill points the way to increased quality and tons per hr capacity . . . .

REPUBLIC Steel Corp. is proud to introduce its "Bar Mill of Tomorrow," which, incorporating the most advanced features, was built to provide high quality hot rolled bars and extra heavy coils for the growing needs of customers in the midwest and throughout industry. The new 11-in. bar mill at South Chicago rolled its first order in April, 1958, following an eighteen-month construction period during which as many as 525 workers participated. Within six and one-half months the mill was up to 20 turns per week operation.

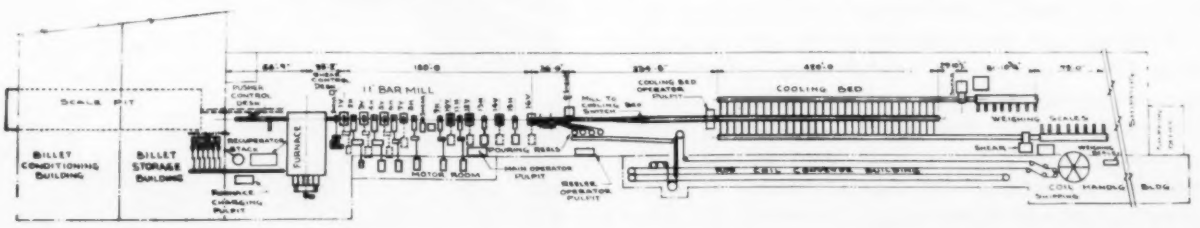
The mill, of the continuous type, employs sixteen straightaway, two-high stands in alternate horizontal and vertical positions. Each stand is individually motor driven. This arrangement together with an electronic control system allows accurate speed control and synchronization. This makes possible the delivery of finished products up to speeds of 3000 fpm.

The entire range of product is rolled from 30-ft 3 x 3-in. and 4 x 4-in. billets. Each billet travels a quarter of a mile from conditioning, to stocking, reheating, rolling, cooling, and finishing. The following finished products can be rolled:

Flats	1 to 4 in. width x $\frac{3}{16}$ to $\frac{1}{2}$-in. thickness
Squares, hexagons	$\frac{3}{8}$ through $1\frac{1}{8}$-in. cross section
Rounds, concrete	$\frac{3}{8}$ through $1\frac{1}{4}$-in. diam bars
Angles	1 x 1 x $\frac{3}{16}$-in. through 2 x 2 x $\frac{3}{8}$-in.
Coils	450 through 1600 lb.

A consideration for locating the new mill at the South

Figure 1 — Plan of Republic's bar mill illustrates the rolling and handling facilities.



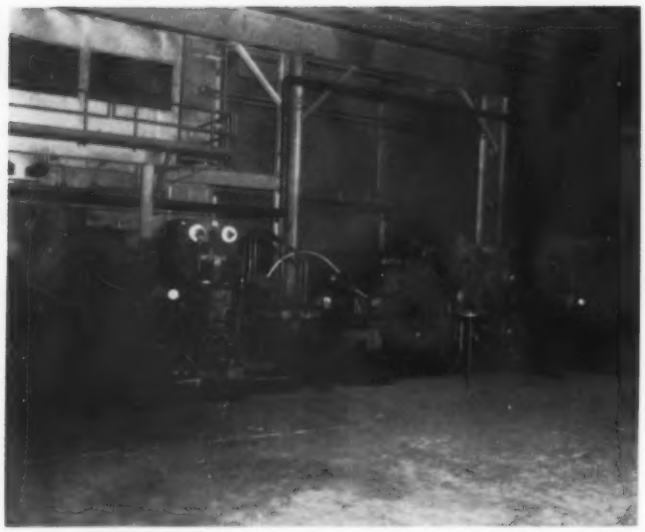


Figure 2 — View of a rolling stand shows the vertical looping arrangement and the looper arm.

Chicago plant was a suitable space between the existing 10 and 12-in. bar mills. This provided the opportunity to consolidate material handling, maintenance, roll shop and scale recovery facilities for all three mills.

After 22,000 cu yd of concrete were poured and 3500 tons of structural steel were erected, four new buildings were ready to house the necessary equipment.

The conditioning building, 110 ft wide and 270 ft long, contains 450 lineal ft of 30-ft wide conditioning skids and is serviced by a 15-ton overhead electric crane. The mill is stocked from a storage building, 110 by 375 ft. This building is equipped with a 15-ton crane, scale and a combination billet unscrambler and furnace charging equipment. Both of these buildings are at right angles to the main mill building. The reheat furnace, roll stands, coil pouring reels, cooling facilities and auxiliary equipment are housed in the main mill building which is 100 ft wide and 1250 ft long. This equipment is serviced by three 20-ton cranes plus a 15-ton crane in the motor control room. Illumination is provided by mercury vapor lamps spaced at 25-ft intervals. Adjacent to the main mill building is a 28-ft wide lean-to extending 600 ft, through which coil cooling carriers loop and run into the coil handling building. The coil handling building, 65 ft wide and 250 ft long, containing inspection and shipping facilities, is serviced by a 15-ton crane.

So much for the "house." For a description of the equipment, we will follow the flow of product from receiving to shipping, stopping along the way to examine the details.

Billets are transported in 15-ton lifts to the conditioning and storage buildings by straddle trucks.

As billets are required for the rolling schedule, the storage crane moves lifts to the scale for weighing and places them on the unscrambler. The operating cab located in the center of the bridge span, affords the craneman a commanding view with maximum safety. Shuffle bars unscramble the lift onto a walking beam bed from which the billets are dropped onto a roller conveyor. Mounted above the roller conveyor is a ram type charging car which pushes up to three billets into the furnace at one time. This equipment is on a platform approximately eight ft above mill floor level.

After the billets are charged, they are moved through the furnace over sloping skids by a cross pusher and are discharged at the far end of the furnace at the opposite side of entry by a pushout mechanism. The furnace is capable of heating 3 x 3 or 4 x 4-in. cold billets 30 ft long to 2300 F at a rate up to 100 tons per hr with a total burner input of 125,000,000 Btu per hr. The hearth, which has an effective area of 33 by 54 ft is divided into a heating zone with 10 burners and a soaking zone with 14 burners. The furnace has a flat suspended firebrick roof. Either mixed gas (natural and coke oven) with a value of 520 to 740 Btu per cu ft, or steam atomized bunker "C" fuel oil, with a value of 150,000 Btu per gal, may be used. Combustion air is preheated in a flue type metallic tube recuperator to a maximum temperature of 800 F and fed to the furnace by a forced draft fan at a maximum flow of 30,000 cfm. Waste gases are discharged through a brick lined steel stack 175 ft high by eight ft inside diameter. All fuel, pressure, and temperature controls are fully automatic. At a signal from the roller, a billet is pushed out of the furnace to begin its travel through the mill.

The mill arrangement consists of furnace pullout rolls, an up-and-down cut shear and 16 roll stands with a crop and cobble shear located after No. 8 stand. No. 1, 3, 5, 7, 10, 12, 14, 16, are vertical stands, while No. 2, 4, 6, 8, 9, 11, 13, 15 are horizontal stands. Pinion pitch diameters are 16¼ in. for stands 1 through 6; 13 in. for stands 7 through 12; 11 11/16 in. for stands 13 through 16. The alternate layout of the roll stands makes it possible to exert the necessary pressure on all sides of the steel without deformation of the bar by eliminating the conventional 90 degrees twist between

Figure 3 — The mill is controlled from an air-conditioned pulpit set high above the stands.

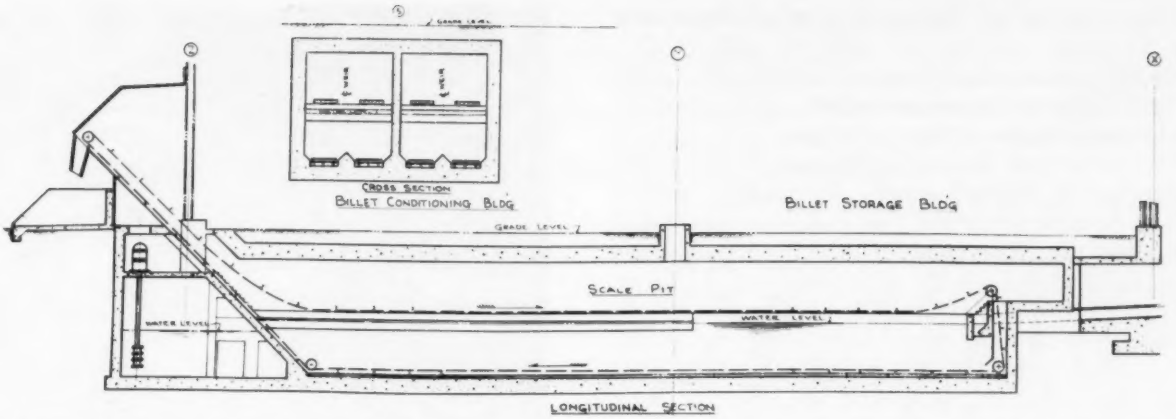


Figure 4 — Cross-sectional view of Republic's unusual scale recovery system shows the operation of the drag chain conveyors.

stands as in an all horizontal arrangement. The bar starts and finishes in a vertical stand.

The crop and cobble shear between No. 8 and No. 9 stands is used to automatically crop cold and split front ends. In the event of a cobble in the finishing stands, the bar is cut into pieces approximately 4½ ft long. This shear is driven by a 110-hp motor and is actuated through a time relay which is tripped when the bar hits a flag on the delivery side of No. 6 stand.

Efficiency in the mill operation is increased by the roll change procedure. To hold delays between setups to a minimum, a complete spare set of housings is available in the build-up area adjacent to the mill proper. All mill housings are of the closed top design. On a mill of this type it is necessary to establish a pass line to which both horizontal and vertical stands can be adjusted.

Horizontal stands and pinion housings are mounted on sliding bases to allow alining of passes with vertical stands. This movement is accomplished by means of hydraulic cylinders. The horizontal stand screwdowns are manually operated through a worm and worm gear mechanism for accurate adjustment. Screw-operated wedges provide for bottom roll adjustment while axial adjustment of rolls is by parallelogram linkage.

The vertical roll stands consist of inner and outer housings and have vertical motor drive adjustment for alinement of roll passes. Roll adjusting screws are provided for both vertical rolls. The screws for the inside roll are used to aline the rolls with the mill center line. The outside roll screws are used for alinement and all other rolling adjustments. The operation of these screws is through worm gears.

The top bearing chuck of the inside roll has the parallelogram adjusting device similar to that used in the horizontal stands. Roll bearing chucks are separated by hydraulic cylinders which maintain the rolls firmly in position.

The design feature which enables us to roll a top quality bar is the mill bearing arrangement. Oil-film, sleeve-type roll neck bearings in each stand give rigidity to the mill, affording minimum roll deflection and close control over the section.

The roll neck bearings as well as the gear drives are lubricated by four circulating oil systems which are located in a cellar below the mill operating floor. Screwdowns and other sliding parts are served by automatic grease systems. Parts not requiring frequent lubrication are served by hand greasing equipment.

A pioneering feature of the mill is the use of vertical loopers at the finishing stands. Up-loop troughs are located at the entry side of each of the four finishing stands. These automatically control the size of the loop, allowing complete rolling flexibility between these stands. Looping arms are actuated by air cylinders which hold the arms in contact with the loop to control any tendency for the loop to hunt. A vernier speed control selsyn is connected to each looping arm trunnion shaft to regulate the speed of the following roll stand in relation to the size of the loop formed. To our knowledge this is the first time that this vertical looping procedure has been employed in the design of an American bar mill.

Another unusual feature is the method of transmitting power to the rolls. The ends of the roll are flat rather than the conventional three- or four-pod wobbler design. Each stand has its own drive motor. The motors for the vertical stands are located in a cellar underneath the mill floor. Horsepower of the motors ranges from 300 for the first stand to 800 for the last stand.

The speed of the motors may be regulated manually from the motor control pulpit. In addition, an ammeter at each of the eight roughing stands assists in setting speed for fine adjustment. A drop in the ammeter reading on one stand indicates that the stand behind it is pulling. A pushbutton control on the stands may be used to correct the speeds.

Electric power for the mill is supplied by four 600, 000 circular unit underground cables at 6600 volts. The individual stand motors are powered by two 3500-kw, 600-volt generators driven by a 9800-hp, 360-rpm, 6600-volt synchronous motor. The generators can be operated separately or connected in parallel by means of a bus tie breaker. This equipment is located in a motor room which is 240 ft long by 40 ft wide for half the length and 20 ft wide for the other half.

Three 1000-kva, 6600/440-volt unit substations provide power for a-c auxiliaries, lights and other low voltage service. One 2000-kva, 600/2300-volt master unit substation furnishes power for the main exciter and high pressure pumps.

Power for the crop and cobble shear and rotary drum shear is furnished by separate back-to-back rectifiers. A separate adjustable voltage motor-generator set supplies power for the coil pouring reels. Power for cranes and other d-c auxiliaries is supplied by a 1000-

kw rectifier located on the main floor of the motor room.

An air filtering system is located on the motor room roof. The mill drive motors are supplied with clean air by fans in the basement of the motor room.

Another feature of the mill is its scale recovery system. Due to the vertical stands, the scale is flushed through a trough alongside the mill into an underground scale pit. A system of sewers brings scale-carrying water from both the 10 in. mill and the 11 in. mill at rates up to 5000 gpm. The pit consists of two chambers, each having two chain drag conveyors traveling 230 ft along the bottom with the water flow and then up an incline, depositing the semi-dry scale on a concrete slab at ground level outside the building.

In describing the equipment beyond the mill proper, the discussion will be divided into two parts: first, to follow the flow of straight bar product; then, coiled product.

The bar line arrangement consists of a rotary drum type dividing shear, a runout table and double cooling beds with finishing unit for each bed.

As a bar delivers from No. 16 stand, it travels 36 ft to the drum shear which cuts it into cooling bed lengths, which then travel over a 235 ft runout table onto the cooling bed rollers. As the bar speeds to the beds, paddle type kickoffs deliver the bar onto either the right or left cooling bed. A system of signal devices and time relays actuate the kickoffs automatically.

The kickoff unit extends 80 ft ahead of the cooling beds which give ample space for the bars to decelerate. This affords maximum utilization of the over-all cooling bed length.

Each cooling bed is 420 ft long. The carryover racks have nineteen notches at six-in. centers. Stationary racks are on ten-in. centers, carryover racks on 20-in. centers. The beds are equipped with pack annealing devices for flats. Table rollers are individually driven, being mounted on motors with double shaft extensions. The rollers are of the truncated cone type and are on 40-in. centers. The last two notches of the stationary racks are equipped with motor-driven V-type rollers spaced at 5 ft-0 in. centers to aline the front end of the bars before they are transferred to the cold runout table by means of shuffle bar units. The cold runout table rolls are 30 in. long and on 5 ft-0 in. centers.

To permit simultaneous operation of both cooling beds, the south cooling bed runout table is 530 ft long, while the north table is 450 ft long. This staggers the finishing units so they can be serviced without interference.

Each finishing unit consists of a bar shear, 75-ft back shear table, scale and cradles. The back shear tables are equipped with three gage heads having electric thrustor lift mechanisms and electric motor drive for transverse movement of the gage. The cradles are located to the center of the mill to provide greater storage along the sides of mill building.

As the bars pass through the finishing units, they are sheared, inspected and bundled for shipment from adjacent rail and truck docks.

The coil line is capable of coiling the full range of rounds produced (3/8 to 1 1/4 in. diam) in coils weighing from 450 to 1600 lb. A bar leaving No. 16 stand may be cut into two pieces by a disk shear before it is fed through pipes to one of the four pouring reels.

Figure 5 — An unusual bucket type unloading mechanism is used for removing coils from the cooling conveyor.

Each reel is driven by a separate adjustable-speed motor. The control is interlocked with the motor driving No. 16 stand. After the coils are formed the stripper plate raises the coil to the mill floor level. A swing type pusher moves the coil onto a chain conveyor about 200 ft long. They are then delivered to a cross conveyor where they are transferred automatically to the hook carrier.

The hook carrier passes into the lean-to adjacent to the mill building and rises to an elevation 46 ft above the mill floor level. It makes a return loop, allowing approximately 1800 ft of travel for coil cooling before it descends to mill floor level where the coils are inspected and tied. The total length of the hook carrier is 2800 ft.

The cross conveyor and hook carrier have a common drive with two booster drives on the carrier to properly distribute the chain load. The hooks are spaced eight ft apart with the open end trailing.

Inspection and coil tying are done while the coil is on the hook carrier. Following these operations, the coil proceeds into the coil handling building. Here it is discharged from the carrier onto an arm of a six arm star wheel. This is accomplished by an unloading mech-

Figure 6 — Republic's "Bar Mill of Tomorrow" has given very successful operation.

anism consisting of a bucket type fork mounted on a pivot arm. The fork receives the coil from the hook carrier, pivots and deposits it on the star wheel arm.

When an arm is loaded, the next arm rotates into place. Coils are removed from the star wheel by a ram truck or by overhead crane equipped with a hairpin hook. Coils are then loaded into railroad cars or trucks at the dock in the coil handling building or transferred to a storage area under the elevated portion of the hook carrier.

So far, this has been a description of modern facilities. Nevertheless, even the latest and best equipment is not without its startup problems, both technical as well as administrative.

Problems began even while the mill was under construction; for instance, in order to start rolling when the equipment was ready, temporary rates and forces had to be established and a complete crew selected. The first crew was hand-picked from the 10-in. and 12-in. bar mills.

On April 7, 1958, the initial crew rolled the first billet. The second, third and fourth crews were added in July, September and October.

Bringing the mill up to expected performance provided a challenge which was accepted with enthusiasm, though we had our share of cobbles and anxious moments. The mill was started on a ½-in. concrete bar in order to focus attention on speed adjustments rather than section problems. In this respect, the vertical loopers required special attention until adjustment techniques were mastered. In conventional looping arrangements, the weight of the bar does not affect the actuating part of the speed controls. However, with the bar looping up, adjustments must be made to compensate for the weight of the bar and the weight of the parts in the control mechanism.

Another startup difficulty encountered was the synchronization of the kickoff paddles at the cooling beds. With operations measured in thousandths of a second, hairline adjustments had to be made in order to properly place the bar on the cooling bed and to prevent interference with the succeeding bar.

Minor problems, which experience and familiarity with the mill will overcome, are still to be solved. Nevertheless, this new facility is an important contribution to the industry.

Discussion

PRESENTED BY

L. M. McDOWELL, Superintendent, Gautier Mill Dept., Bethlehem Steel Co., Johnstown, Pa.

D. E. WEAVER, Superintendent, Finishing Mills, Republic Steel Corp., Chicago, Ill.

FRANK B. GOLLEY, General Superintendent, Finishing Mill, Wisconsin Steel Div., International Harvester Co., Chicago, Ill.

ALBERT RUPP, Superintendent 10 and 14-In. Merchant Mills & P. & C. Dock, Indiana Harbor Works, Inland Steel Co., East Chicago, Ind.

JOHN H. HITCHCOCK, Chief Mechanical Engineer, Morgan Construction Co., Worcester, Mass.

L. M. McDowell: Will you state what advantages you have realized in finishing the bars in a vertical stand instead of a horizontal stand?

D. E. Weaver: There are no twist guides on the delivery side of the leader. This reduces scratches and gives the roller a better control of the oval.

L. M. McDowell: Does this new mill have any cooling facilities for controlling coil temperatures?

D. E. Weaver: We have two 250-psi pumps for descaling at the reels.

L. M. McDowell: The present consumer demand for alloy steels has resulted in need for better pack annealing. The wide range of flats rolled on this 11-in. mill, from one to four in. wide must present problems of annealing and keeping bars straight. Would you describe the facilities you have and what additional men are needed when annealing is done?

D. E. Weaver: No additional men are needed when we roll flats and springs. We encountered some straightening problems while teaching cooling bed operators to run the bed. We are still teaching the operators the proper method of packing to prevent annealing problems.

Frank B. Golley: The problem of training men for the operation of a modern mill is becoming greater. The efficiency of modern electrical and electronic equipment has permitted a reduction of the labor force, but has introduced a complexity in operations requiring added knowledge on the part of labor and supervision. Starting problems are increased considerably.

Albert Rupp: The hearth is divided into a heating zone with ten burners and a soaking zone with 14 burners. Please comment on the advantages of this type of a furnace, as opposed to a single heating zone furnace, for heating merchant mill billets.

D. E. Weaver: We use a larger number of small burners to get uniformity across width of the furnace. Two zones are used to be able to heat at all rates of operation with maximum efficiency and a minimum decarb, i.e., we use the soaking up to its maximum capacity and when the furnace cannot keep up with the mill we add the top zone.

Albert Rupp: The ends of the roll are flat rather than the conventional three- or four-pod wobbler design. Has the "flat" design proved successful to date?

D. E. Weaver: We feel that it has. It provides us with a tighter mill and less backlash.

Albert Rupp: The last two notches of the stationary racks are equipped with motor-driven V-type rollers spaced at 5 ft-0 in. centers to aline the front end of the bars. How does this method compare with the practice of alining the front end at the shears by bumping the bars against a block?

D. E. Weaver: Bars are alined before they get to the shear, particularly on the small sizes that tend to spring out when they are bumped against the block.

Albert Rupp: Is scale a problem on the large section coils?

D. E. Weaver: Up to now, we are experiencing a heavy scale on the large coils.

John H. Hitchcock: Having lived through the startup period, let me say from personal observation that Republic's pride of ownership is fully justified, not only in the possession of the mill, but in the skill with which the mill was put into operation in a short time. ▲

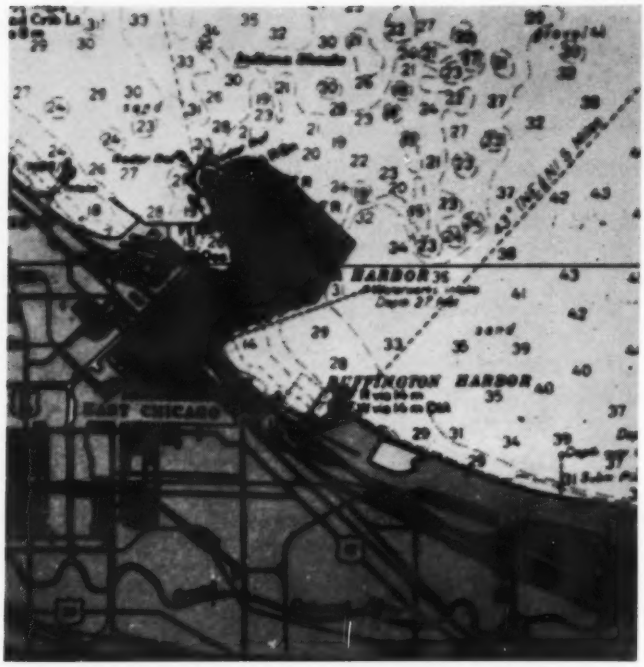


Figure 1 — Inland Steel Co. is on the shore of Lake Michigan between Chicago and Gary, about 20 miles from the Chicago loop.

Engineering The 1955–1958 Inland Steel Co. Expansion Program

. . . . a well planned and organized expansion program permits economical and orderly construction . . . .

by I. ROSENAK
Chief Engineer
Indiana Harbor Works
Inland Steel Co.
East Chicago, Ind.

AT the beginning of 1955, Inland Steel Co.'s Indiana Harbor Works had a rated capacity of 5,000,000 annual ingot tons. The plant was closely balanced as to capacity of iron making, steelmaking, blooming, intermediate rolling and finishing. In these production areas, blooming was probably the most critical bottleneck. Upon management's decision to embark on an expansion program, the engineering dept. was assigned the design of a facility to provide approximately 40,000 tons per month of additional finished product in cold rolled sheet and strip and possible future expansion to the capacity of two cold reducing tandem mills.

In the development of this project, Inland engineers were faced with basic problems which involved:

1. Selection of the proper equipment to produce necessary hot metal, steel ingots, slabs and hot and cold rolling facilities.
2. Selection of a location for these facilities which would provide suitable tie-in with existing equipment.
3. Development of a material flow plan involving the least cross-haul of steel in process.
4. A plan compatible with a long range program

which would allow future expansion of the facilities being developed.

It is recognized that these basic problems are the kind usually faced by all steel plant engineers in developing any expansion program; however, in Inland's case, circumstances existed which made the problems involved in engineering such a program at the Indiana Harbor Works more complicated than the usual problems in engineering a large expansion program. These included:

1. Whether to install a slabbing mill or provide continuous casting facilities.
2. Whether to locate equipment on existing land or create new land.
3. Foundation problems connected with heavy equipment and structures on newly placed fill.
4. Litigation in connection with creation of land.

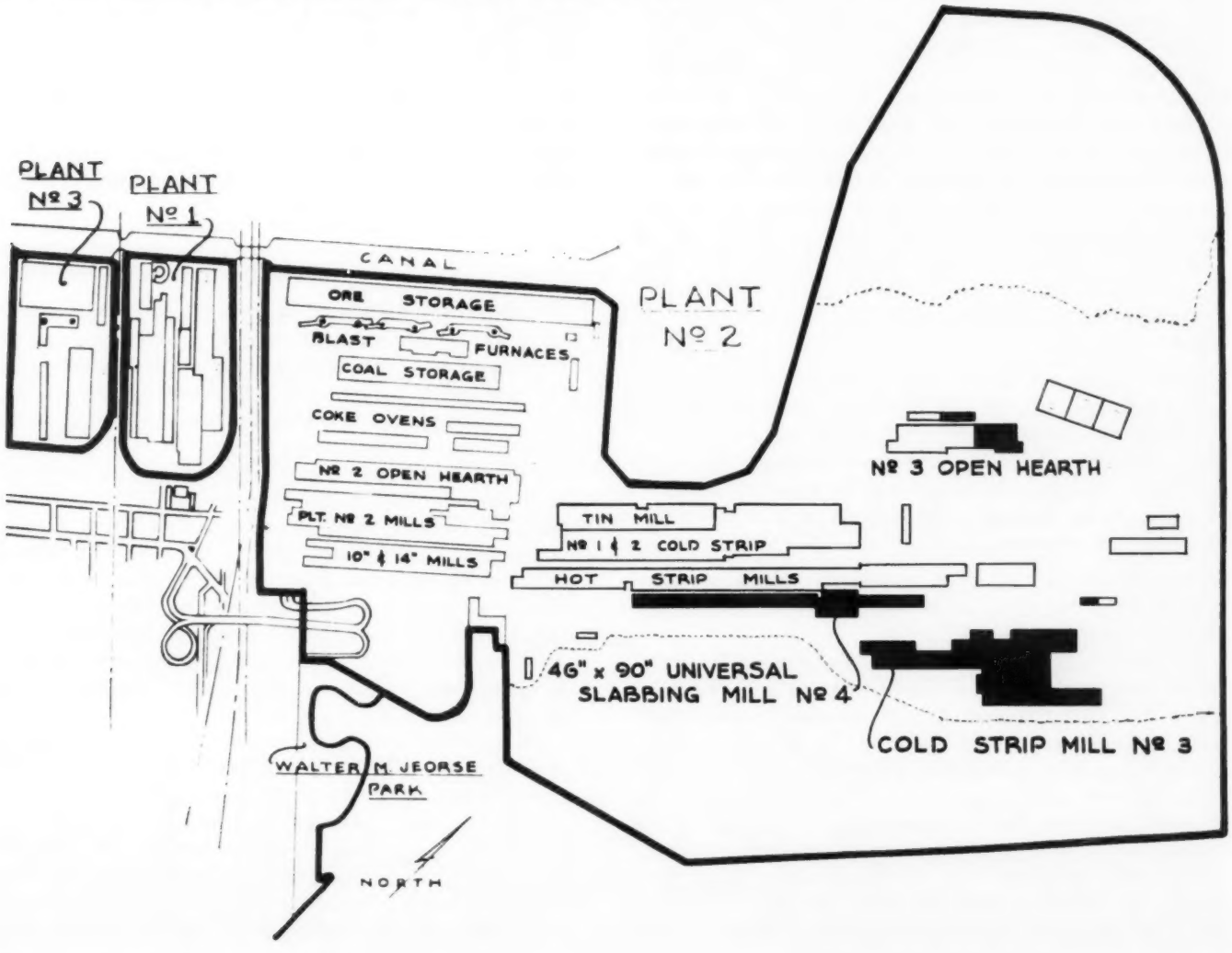
DEVELOPMENT OF SITE

The Indiana Harbor Works of Inland Steel Co. is located on the shore of Lake Michigan about 20 miles south of Chicago's loop. The plant was started in 1901 on a 56-acre plot near the shore of the lake. Lake Michigan adjacent to this original plant was comparatively shallow; that is, less than 30 ft in depth. This shallow water, known as the Indiana shoals, extends several miles into the lake. Since normal shipping lanes do not cross these shoals, Inland, as well as other industries located along the lake shore in this area, has been able to obtain permits from the Federal Government to fill over these shoals and to create land. In 1908, Inland obtained a permit to fill about 200 acres adjacent to the original plant. Additional permits up to 1954 allowed Inland to create a peninsula more than 800 acres in area and extending two miles into Lake Michigan. This acreage has been filled by a combination of internally generated slag and by sand dredged from the lake.

In the preliminary development of the 1955–1958 expansion program, the logical equipment site appeared to be east of the existing hot strip mills. At that time, the area was in Lake Michigan. Anticipating a need for this area, Inland in 1954 applied for and was granted a permit to fill 533 acres of the lake on the eastward side of the plant.

In obtaining a fill permit, an application is made to the U. S. Army Corps of Engineers. This application

Figure 2 — This is a simplified map of the Indiana Harbor Works. The area designated as Plant No. 1 is the original 56 acres established in 1901. The old shoreline of the lake was along a line directly to the right of Plant No. 1. Practically all of Plant No. 2 was built on filled land. Also shown is the new park which was built by Inland for the city of East Chicago. The new facilities which constitute the 1955–1958 expansion program are shown in solid black. They are: No. 3 open hearth. 46 x 90-in. universal slabbing mill No. 4, and cold strip mill No. 3.



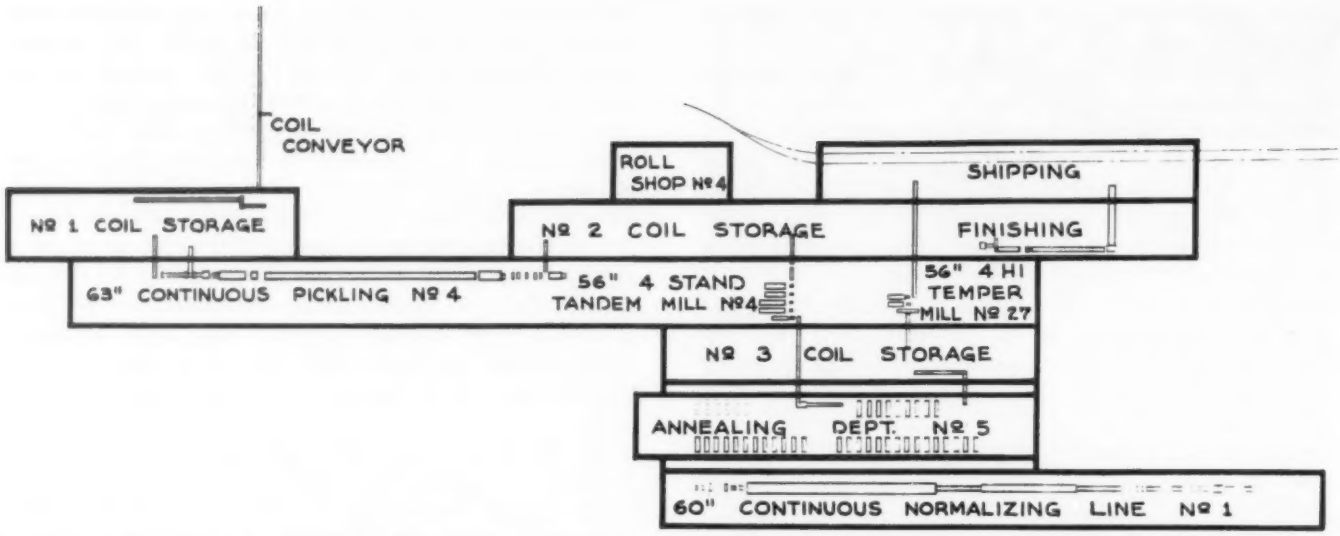


Figure 3 — Simplified diagram of cold strip mill No. 3 illustrates the solution of the problem of material flow through this mill. Coils from the hot strip mill are delivered by the underground coil conveyor at the top left hand corner of the figure. The coils are stored in No. 1 coil storage building, are fed by conveyor to the 63-in. continuous pickling line, then delivered by conveyor to No. 2 coil storage building. From the No. 2 coil storage building, coils move by conveyor to the 56-in. four-stand tandem mill, and from there are delivered by conveyor to No. 3 coil storage building. The same conveyor delivers coils to the annealing department. After annealing, the coils are returned to No. 3 coil storage building. Another conveyor moves the coils from No. 3 coil storage building to the temper mill and from the temper mill to the finishing and shipping buildings. The 60-in. continuous normalizing line is fed from No. 3 coil storage area by means of a transfer buggy.

describes the area to be filled with a metes and bounds description. It states the use to which the area will be put and describes the means of protecting the shore area to prevent escape of fill material beyond the permit limits. The application is accompanied by drawings which are made in an exact manner required by the Corps of Engineers. The Corps of Engineers must be assured that the proposed fill will have no adverse effect on shipping in the area. To prepare the necessary background for recent applications, Inland had a model of its plant area, including the canal, turning basin and surrounding waters, made and tested at the Corps of Engineers Waterways Experimental Station at Vicksburg, Miss. Based on the results from the above tests, the eastward expansion enclosure was designed as follows:

Sheet piling cells about 28 ft in diameter are filled with open hearth slag for the northern most edge where wave action is greatest.

On the eastward side where wave action is not so large, the final shore line will be an open hearth slag berm capped with limestone, placed in a random manner.

Following the approval of a federal permit, a state permit and permission of the State Conservation Dept. must be obtained.

Before obtaining permits to fill lake area, Inland had to obtain riparian rights which were, in part, held by the city of East Chicago. Inland and the city had made an agreement by which Inland would receive these riparian rights by acquiring a five acre lakeside park from the city; and in return, Inland would build a new 20-acre park for the city, including a bathing beach and a pleasure boat marina in an adjacent lakeside area. This agreement was challenged and taken into court, precluding Inland's starting the fill. With the legal status of this area being tested in the courts, it was necessary to plan for alternate locations of the required facilities. Therefore, layouts were developed for locating the slabbing mills and the cold strip mill not only on newly filled land east of the plant, but in other areas as well. In fact, orders were placed for some of the major items of equipment before decisions were made as to where this equipment would eventually be placed. The courts finally upheld Inland's riparian rights to the area east of the plant through the agreement with the city, and the decision was made to locate the new facilities in this area.

PRODUCTION FACILITIES

In order to select the best plan for production facilities, various alternate plans are set up and studied as to advantages and disadvantages of each. Consideration must be given to initial investment, operating cost, time to install and interference with other producing units during construction.

A study of the hot metal requirements showed that the necessary hot metal for this program could be provided by the addition of one new blast furnace blower rated at 125,000 cfm at 35 psi. This blower provided higher pressure at the top on one furnace and allowed an increase in wind on other furnaces. The increased wind volume and pressure, along with some other improvements in ore and coke quality, resulted in an increase in hot metal of approximately 557 net tons per day.

An intensive study was made on the question of providing the necessary steel requirements for the program by means of the oxygen converter process. Due primarily to the shortage of hot metal, it was determined that this method was not feasible for Inland at that time, and the decision was made to build three new open hearth furnaces of 315-ton capacity which were added to an existing four-furnace shop built in

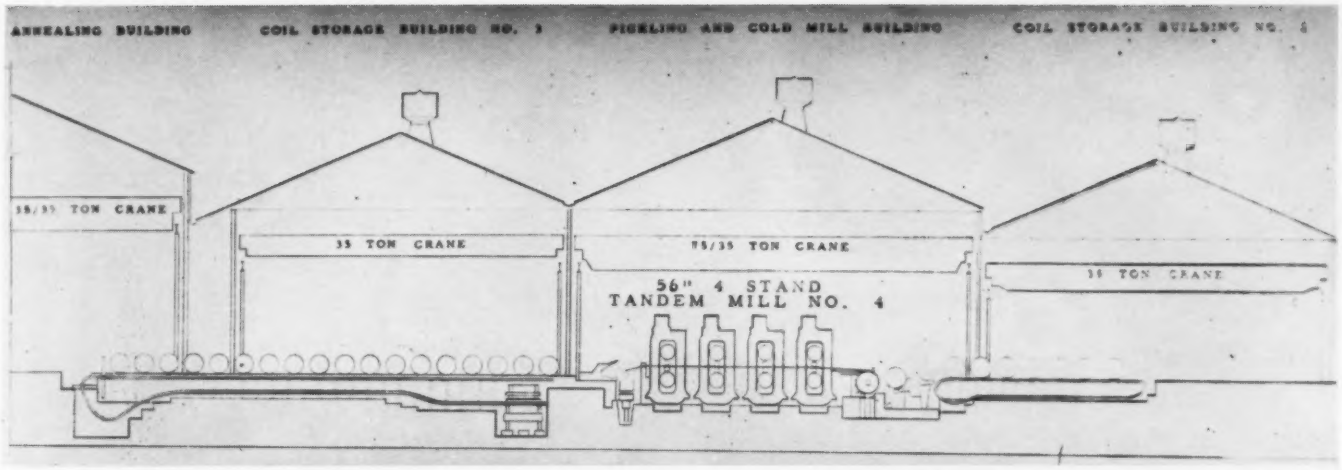


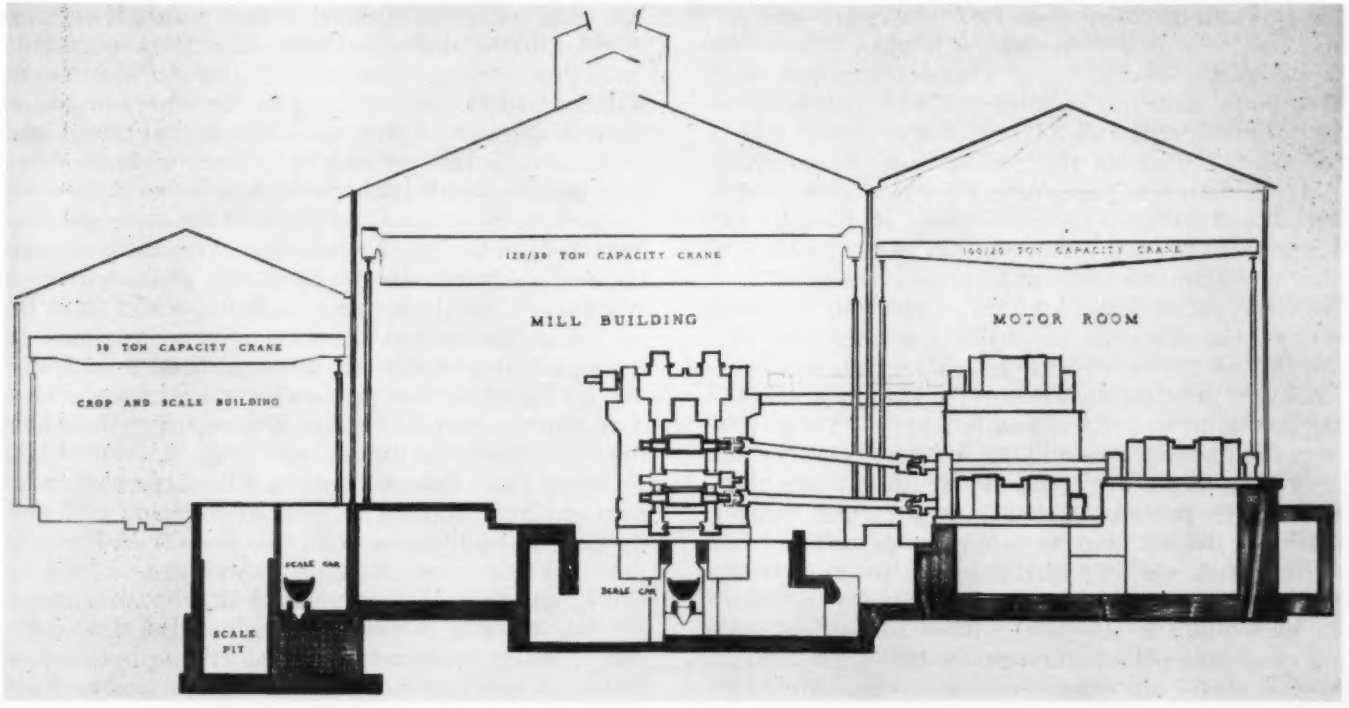
Figure 4 — A typical cross section of the mill buildings. This cross section is taken through the four-stand tandem mill and shows the coil conveyor from the coil storage building No. 2 at the right delivering coils to the mill and the conveyor taking coils from the mill to coil storage building No. 3 or the annealing building.

1951. At the same time, the capacity of the original four furnaces was increased from 275 to 315 tons each, and some other improvements were made in other furnaces. The plant annual ingot ton capacity as a result of all these improvements was increased by 800,000 ingot tons. Other programs approved more recently have further increased the plant capacity to a rating of 6,500,000 ingot tons.

Since the slab requirements for this program would not use the entire output of a new modern slabbing mill, considerable study was made on the necessity of building such a mill. In order to get the necessary additional production of hot band out of Inland's existing hot strip mills, it was necessary to provide slabs up to 75 in. in width. The continuous casting of slabs was studied as an alternate to a slabbing mill. This study and experimentation, over a period of many months, indicated that this process would not answer the needs of the program.

Final approval on construction of the slabbing mill was given approximately seven months after approval on other parts of the program. The location of the stripper required for the new slabbing mill was also a matter of question. Studies were made on locating the stripper either in line with and adjoining the new soaking pit building, or at some distance from it, in order to allow future soaking pit expansion and to provide for necessary ingot storage tracks between the stripper and the soaking pits. The selected location for the new stripper was about 1600 ft north of the soaking pit building. When erection of the new stripper including its crane was completed, an existing stripper facility was dismantled and re-erected as a north extension to the new stripper. This provided a building 380 ft in

Figure 5 — A cross section through the No. 4 universal slabbing mill. The two horizontal roll drive motors and the vertical roll drive motors are outlined in the motor room at the right. The underground railroad for removing scale from the mill shows one scale car in position directly under the mill and another scale car at the left in the dumping position.



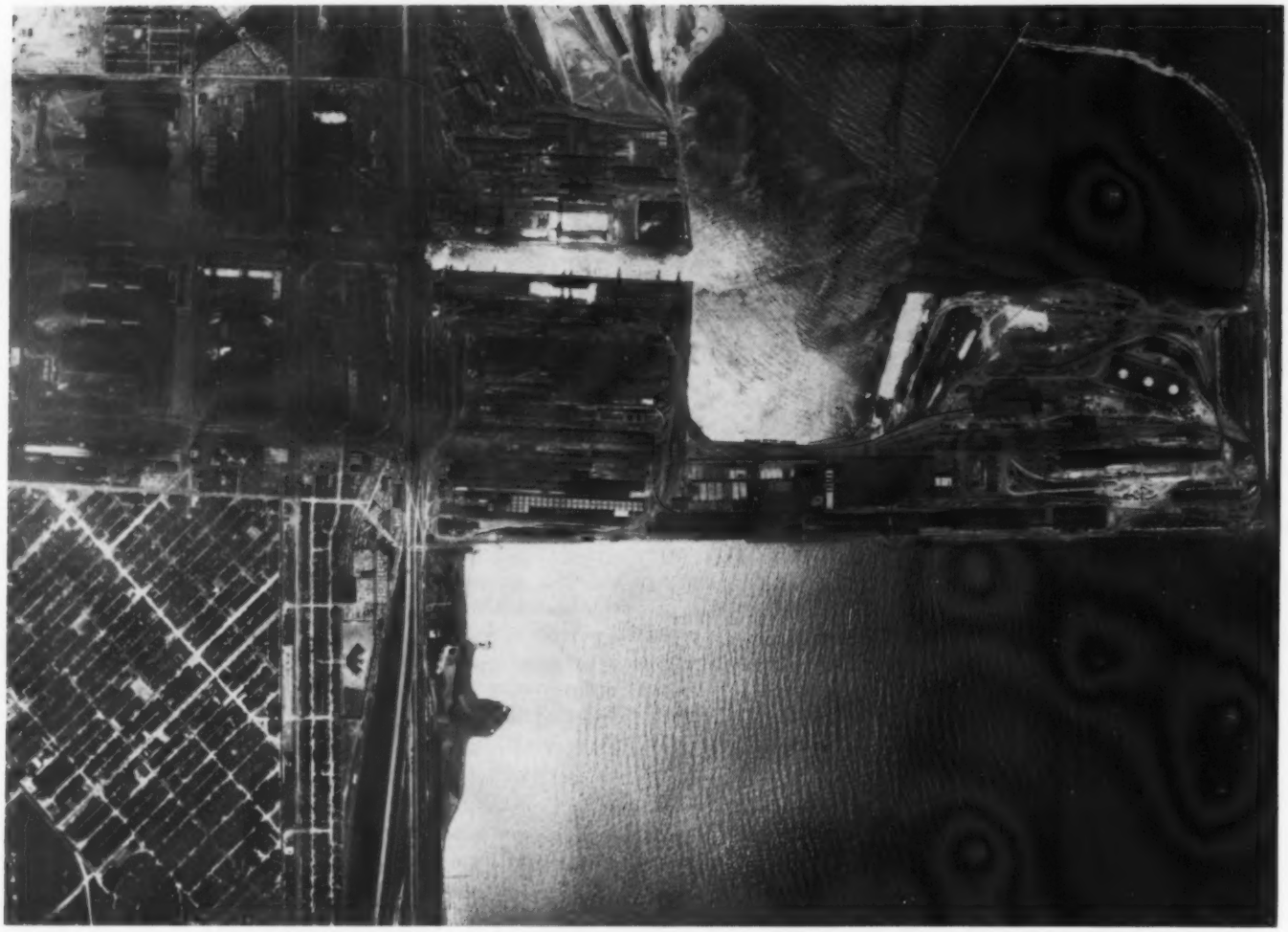


Figure 6 — Taken in July, 1955, the beginning of fill for the lake front park is shown. At this time, none of the fill had been started for the expansion program.

length with two stripper cranes.

In this program, only part of the total complement of soaking pits for the new slabbing mill were built. Six batteries of three pits each were constructed, providing 1840 ingot tons under cover. It was intended that this mill be operated on two eight-hour turns per day with four hours between each turn, to provide for adequate soaking time. The slabbing mill is a 46 × 90 in. universal slabbing mill with 12,000 hp on the horizontal rolls and 4000 hp on the vertical edger. To take full draft on the vertical rolls, when rolling either directions, requires precise control of speed and vertical and horizontal screw settings. It was felt that this required too many decisions in too short a time to allow optimum operation of the mill by human control. Therefore, punch card control was provided for these settings. In addition, punch card control was also provided for the tables, side guards and manipulators.

Another problem involved in the design of this mill was how to provide for adequate removal of scale and scrap from beneath the mill under future operations at 19 or 20 turns per week. Inland's solution to this problem was to provide scraper conveyors and sluicing under the tables, and in addition an underground railroad track was built directly under the mill. Dump cars are lined up on this track directly under the center line of the mill at the point where the heaviest scale and scrap comes down through the tables. As the cars become filled, one empty car is pushed into place and a full car removed without any hindrance to mill operations. The full car is then hauled around to the scale pit and dumped.

The slabbing mill discharges its slabs into a new slab yard about 1600 ft long by 126 ft wide which parallels and is adjacent to the old slab yard currently serving the 44 and 76-in. hot strip mills, and which also receives slabs from No. 3 blooming mill. Six transfers were installed and two new scarfing gantry cranes placed in the new slab yard so that all slab processing takes place in one area in the new slab yard. The old methods of slab handling with chains, which required a crew of hookers on the ground, was studied for other possible improved methods. The five new overhead cranes in the new slab yard were equipped with what are termed "ice tongs," which can grasp a 50-ton pile of slabs by the sides. These tongs require a minimum amount of space and can pick slabs up, move them, set them down, unpile and repile them without the use of ground crews.

In order to increase the hot strip capacity, three new furnaces were installed in the 76-in. hot strip mill replacing three existing furnaces. The old furnaces were torn out and replaced without interrupting mill production. In addition, a new scale breaker and several new mill tables were installed, as well as new 5000-hp drive motors for No. 3 stand and 5750-hp drive motor for No. 4 stand. A new rotating mandrel downcoiler was installed to complement the existing two downcoilers. A new slab heating furnace was also installed

Figure 7 — One year later—July, 1956, the park fill, in the lower left hand corner, is nearly completed. The forebay for the pump house intake has been built and the first berms can be seen in the lower right hand corner.

in the 44-in. hot strip mill to improve the productive capacity of that mill. An underground coil conveyer approximately 960 ft in length was installed from the 44-in. mill to the coil storage building in the No. 3 cold mill area. New facilities erected in the new No. 3 cold mill were as follows: a 63-in. continuous pickling line, a 56-in. 4-stand tandem mill, a 56-in., 4-high temper mill, 12 annealing furnaces, each accommodating four stacks in line of 73-in. diam coils, and four single stack furnaces. Four HNX atmosphere gas generators with a capacity of 20,000 cfhr each, a 63-in. combination shear line and a 60-in. continuous normalizing line were also installed. This normalizing line, which is a new and unique design, is over 1000 ft in length. A new roll shop containing three roll grinders and one contour roll lathe was built for the new cold mill. Practically all coil handling in the new cold mill is done by means of conveyor and cranes. There are no ram trucks or fork trucks used in the new facilities. Conveyors for the most part are designed with the conveyor top at floor level. A shipping area is provided with a drive through, truck docks and double track for rail shipment.

UTILITIES EXPANSION

Since this expansion was in an entirely new area, all utilities had to be installed. A forebay was built for water intake. The forebay, which is approximately 350 ft wide, was constructed by means of erecting sheet piling cells about 28 ft in diam in the open water of the lake prior to the start of filling operations. The water entrance into the forebay is through three electric fish screens. The water then flows through a trash rack. The forebay is cut in two parts by a sheet piling wall containing hinged gates. Eight pumps, of 100,000-gpm capacity each, elevate the water a maximum of seven ft so that the water level in the inner portion of the forebay is higher than the lake level. The amount of this elevation will depend upon lake level and provides for a constant head on the various pumps which provide service water for the entire plant. Since filling of the new area would cut off the intake for an existing pump house, two 96-in. diam concrete pipes were buried in the fill under water to provide for an intake for this pump house which has a capacity of approximately 120,000 gpm. All of this installation had to be made without shutting the pump house down. Four separate sewer systems were built for the area: one clear water sewer, one dirty water sewer, one sanitary sewer and one acid sewer. The clear water sewer, which consists primarily of cooling water which has not been polluted, flows directly to the lake. The dirty industrial waste sewer empties into a lagoon at the north end of the property. In this lagoon, the solid matter is allowed to settle out, and oil is taken off the top of the water by means of a skimmer. A complete sewage treatment plant was built in this area to treat all of the sanitary sewage, and the effluent

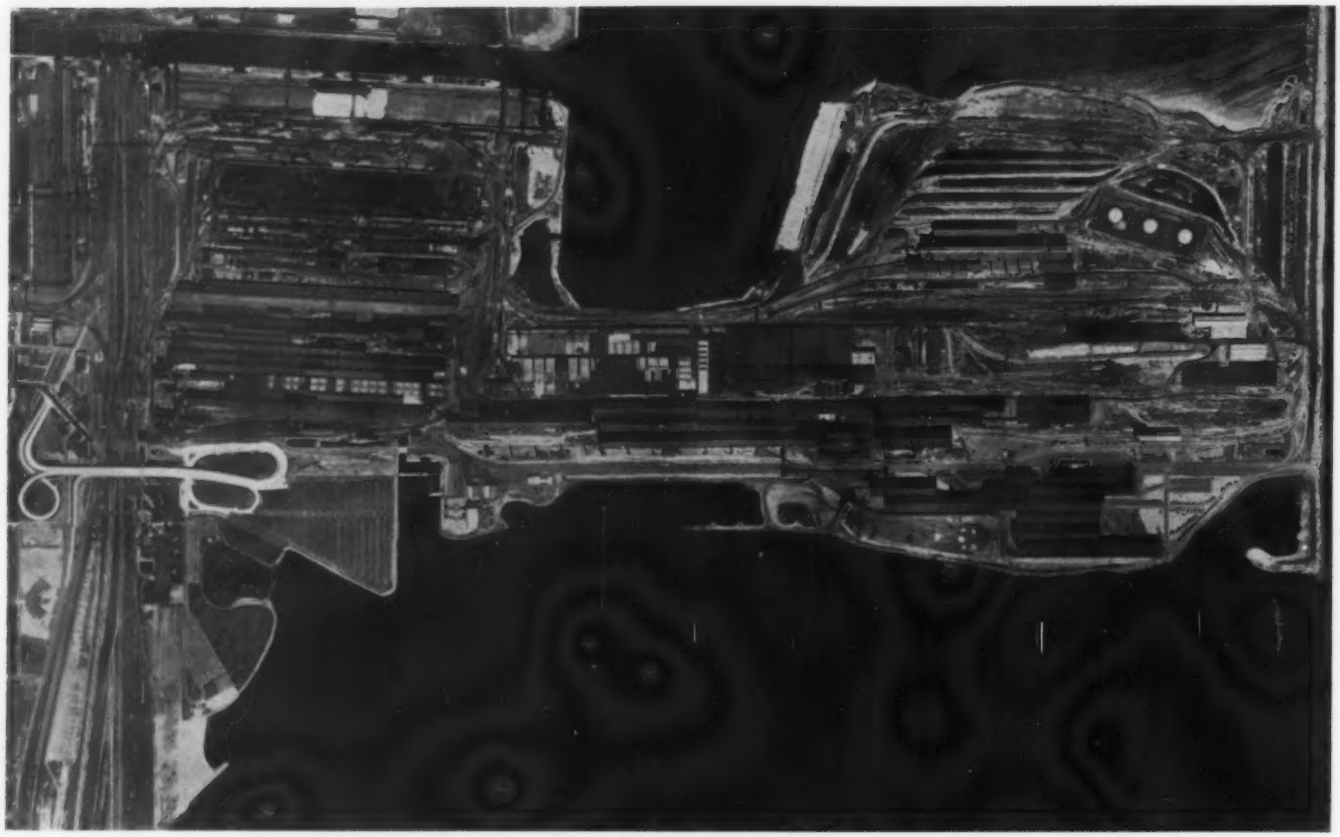


Figure 8 — In August, 1959, the expansion program is complete, the lake front park, overpass and parking lot are complete and at the top center, construction is underway on a new sintering machine, which is another program.

discharging from this plant is of very good quality. The acid sewer is carried across the plant to combine the existing acid sewers on the west side of the plant. A high pressure fire line was installed to supply hydrants throughout the area.

Prior to this expansion program, Inland had generated all of its own power, primarily with waste heat and waste fuels such as blast furnace gas and coke oven gas. In this expansion program, we made our first tie with a public utility system. At the time of this tie, Inland's plant generating capacity was 150,500 kw, which was all generated at 25 cycles. A 12,500-kw Scherbius type frequency converter was installed. Transmission lines were brought into the plant, with two sources of power from Northern Indiana Public Service Co. feeding two 25,000-kva transformer banks. To facilitate installation of utilities in this and future plant expansions, a service corridor having a minimum width of about 200 ft was kept open between the new No. 3 cold mill and the balance of the plant. This corridor provides space for electric transmission lines, sewers, water mains, roads and railroad tracks.

Inland's permit from the Federal Government allows a filling operation on the eastward side of the plant of approximately 533 acres. The expansion program just completed has required filling about 130 acres for production facilities, 50 acres for a new railroad overpass and employees' parking lots and another 20 acres for the new city park. This required placement of approximately 12,000,000 yd of fill material in the period from 1954 to 1959. Roughly three-quarters of this material was plant generated slag. The remainder was sand which was obtained in two ways. The major portion of the sand was obtained from the lake by using an 18-in. dredge which was purchased and utilized for three years; a minor portion of sand was purchased and hauled in by truck. Fill was placed to a yard elevation of 16 ft above the lake level with most building floors being 4 ft higher.

Prior to the start of lake filling operations, 27 soil borings were made, each about 150 ft deep into the lake bottom, in accordance with a previously determined pattern. These were studied, and tests were made, to determine the characteristics of the subsoil below lake bottom and to determine fill placement procedures that would result in the most compact fill with the least possible future settlement. While primary concern was for minimizing future settlement resulting from superimposed loads on the fill, a problem of even greater consequence was the potential settlement which could result from displacement of the underlying soft clay deposits under the load of 40 ft or more of new fill.

In accomplishing the fill program, the construction procedure was to isolate a small area of the total by means of a berm constructed of open hearth slag. After the area was completely enclosed with this berm, the interior was filled with hydraulically placed sand and blast furnace slag in combinations previously mentioned. It was recognized that certain pieces of equipment, particularly those in soil areas of low shearing resistance, would require piling under the foundations to minimize settlement. However, when practical, the foundations were designed as spread footings.

In general, all of the buildings are on spread footings, with provisions made for expected settlement.

Building floors are not tied into foundations so that they can settle independently. Piling has been placed primarily under heavy machinery such as the slabbing mill proper, the 56-in. 4-stand tandem mill and the temper mill. The piling under the tandem mill and temper mill supports a tub foundation in which the mill foundations were constructed. The area between the mill foundations and the tub walls has been retained for basement purposes. This basement area was utilized for the oil systems, ventilating and hydraulic equipment, and was adequate for these installations.

Since Inland rolls wide flange beams, a decision was made to roll our own piling. After physically testing the various sections, it was decided that the most economical would be a 12 by 12-in. piling section rolled slightly thicker than the standard section and weighing approximately 55-lb per ft. The piling was driven to four blows per in. with a 32,000 ft-lb hammer. The piles, which were 100 to 110 ft in length, were designed to support approximately 60 tons each. Because the construction was in a newly filled area, the usual construction procedure was reversed and, instead of excavating for foundations, the foundations were built on the fill when it had reached an elevation slightly above lake level. Following this, the fill was brought up to finished grade. One of the more difficult problems was the construction of a pit 60 ft deep, 38 ft long and 13 ft wide for a looping pit in the pickling line. The excavation for this pit, which extended more than 40 ft below the lake level, was made without shoring. The excavation was dewatered by means of several rings of well points. The concrete pit walls were then formed and poured in the conventional manner.

Early in the program, an economic study was made of the various building cross sections to determine the most economical in terms of lowest cost usable area, taking into consideration the cost of buildings, utilities, and cranes. It was determined for our purpose, that a 126-ft span building with 120-ft crane span was most suitable. The building structures utilize wide flange beam sections wherever possible. Most of the buildings for processing of cold rolled strip had to be insulated. For these buildings, sandwich roof construction was used which consists of one layer of 18-gage galvanized roof deck and a top layer of corrugated galvanized sheeting with 1½-in. fiber glass insulation in between. Building heating, where required, is provided by rotary high velocity heaters located in the roof above the crane runway, directing blasts of hot air toward the floor. These units have an outside air intake and can be used for summer ventilation.

SUMMARY

The initial request for authorization to proceed with the 1955–1958 plant expansion program was presented to management in October, 1955, without benefit of firm quotations on equipment by the suppliers. After all quotations had been received on major items of equipment, a final authorization was presented and approved.

The request for authorization promised start of operations in November, 1958. The new open hearth furnaces were the first portion of the program completed, and the first steel was tapped from these furnaces on August 6, 1957. The first slab was rolled on No. 4 slabbing mill on October 27, 1958. The various units in No. 3 cold strip mill were placed in operation between September and December, 1958.

Some vital statistics indicate the magnitude of the engineering requirements for this program. During the engineering of this program, the Inland engineering department consisted of about 129 people of whom 68 were engineers, the balance being draftsman and clerical employees. To assist in decision-making, committees consisting of engineering and plant operating and maintenance supervisory personnel were formed for this purpose. The first responsibility of the committee was to prepare scope lists for the facilities to be constructed in its specific area of responsibility.

Although these plant supervisory people continued in their normal responsibilities, the engineering department drew heavily upon their time and efforts during the entire program.

To engineer such a large program, the services of many outside engineering firms were used. Inland engineers acted as co-ordinators with the outside engineering firms. During the course of the program, 32 engineering consultant firms contributed to the engineering. At one time, over 300 people on consultants payrolls were working on the project.

There were approximately 10,000 drawings made, not including thousands of engineering drawings made by the suppliers of the mechanical and electrical equipment. It is estimated that the number of drawings made represents 500,000 man-hours of total engineering time. New buildings erected cover 39 acres. Some 43,000 tons of structural steel were erected; 440,000 ft of load bearing piles were driven and over 200,000 cu yds of concrete were poured. Utilities included eight miles of main pipelines, five miles of sewers, eleven miles of track and four miles of blacktop roadway.

Many engineering problems have been set forth here indicating the magnitude of the job of engineering Inland's 1955–1958 expansion program. This program is now complete and subsequent expansion programs are under construction and are being engineered, as the engineering of plant improvement and expansion in a modern steel mill is a never ending job. The program described here has met its production objective; was completed on time and was completed within a fraction of a per cent of the authorized expenditure.

Discussion

PRESENTED BY

H. I. MARTIN, President, Swindell-Dressler Corp., Pittsburgh, Pa.

STEPHEN VAJDA, Staff Process Design Engineer, Jones & Laughlin Steel Corp., Pittsburgh, Pa.

S. P. CURTIS, Chief Engineer—Steel & Coal, Central Operations, United States Steel Corp., Pittsburgh, Pa.

H. I. Martin: I am sure that while Mr. Rosenak was preparing this paper he must have smiled to himself when he realized the number of hours of strenuous discussion he was condensing into a few words describ-

ing an apparently easily solved problem. We, as engineers, well know the goals we attempt to achieve on any engineering project, and when Mr. Rosenak can summarize:

1. The program has met the production objectives.
2. The project met the tight construction schedule.
3. The project was completed within the budget.

Stephen Vajda: The author very properly points out the problems of establishing the scope of a project. One cannot consider only the immediate need, but must tailor it to be compatible with the future. How much can one afford to spend now in anticipation of future use? For instance, for an ultimate layout of two lines, should one put in the piling for the second line, the foundations, the building?

Exactly what tonnage does one design for? A little extra steel in the building columns will give a very attractive increase in crane capabilities for a nominal sum. How much should you build into the crane? What are the probabilities that improved technology will increase the capacity? Speeds that were unheard of five years ago are taken for granted today.

Automatic controls, card programming, improved materials and so forth, all tend to increase productivity.

After you have defined your scope, layout problems certainly cause many headaches. Inland had room to expand. Most plants are so hemmed in that the dismantling of some existing facilities is a must. Then begins the job of inserting the new facilities with a minimum of interference with operations. Compromises must be made on the ideal flow of materials, expedients devised for circumventing bottlenecks, etc.

Now the engineer's main job has just begun, the design of the equipment and process under consideration. What is the status of competitive lines? What are their bottlenecks and trouble spots? How can the product be improved? How can the productivity be increased? Are existing concepts obsolete? All these require discussions with the equipment manufacturers, visits to existing lines and meetings with your own operators.

Then comes specifications, bid requests, comparison of bids, awarding of contracts, followed by the detail design considerations, approval of drawings and revisions.

Erection in the field brings its share of problems: underground lines not shown on existing drawings, steel buttons in a slag fill, variations in soil conditions, etc.

The start-up of the plant can be heartwarming or heartbreaking. Someone made a mistake on the wiring—a burnt-out bearing—no grease—failure of components—excessive wear—etc. One plant may start up overnight, another may go on for months.

Up to now we have ignored the problem of estimating the cost. Certainly you have a bid on the main item, but what about the miscellaneous items, maintaining of operations, those unforeseen interferences, those unexpected start-up problems? How do you compensate for escalation in labor and materials, what about overtime?

Sometimes one wonders if there is not an easier way to make a living, but it is surprising how quickly one forgets the problems and heartaches when one watches the product come out. One feels a little extra pride in the completion of a difficult job and is anxious to start on the next one.

S. P. Curtis: Of special interest is the discussion of the development of the site, the most important single subject in the paper; also, the several notes on material handling as well as the reported rather generous dimensions of the main buildings. The organizing of committees composed of engineering and plant operating people to aid in the successful carrying out of this large project is particularly noteworthy. ▲

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Expansion of Inland's No. 3 Open Hearth Shop

by R. G. PHELPS,
Manager, Steel Production
Indiana Harbor Works
Inland Steel Co.,
East Chicago, Ind.

Inland's expansion program indicates that the efficiency of the open hearth can be greatly increased through modern shop practices.

INLAND'S No. 3 open hearth started operations in 1952 as a four-furnace shop. The initial plans called for an eventual expansion to six furnaces. For this reason, hot metal handling facilities and ladle relining equipment were installed in an open bay between the third and fourth furnaces. Piling was also driven for the fifth and sixth furnaces so that subsequent damage to the foundations of the fourth furnace could be avoided.

The original shop layout and general furnace design proved very satisfactory, and productivity far exceeded the design capacity. However, a good open hearth organization cannot be static. There must be a continuing drive for lower costs and increased productivity. It was inevitable that certain deficiencies in equipment would appear as the tempo of operations increased. The expansion of the shop in 1956 presented a unique opportunity to correct the deficiencies which had been uncovered by actual operating experience.

The decision to build three additional furnaces in No. 3 open hearth was based upon two factors. Total ingot capacity needed to support the increased rolling facilities to be built dictated that three furnaces be added instead of the two planned initially. The other factor, which ruled out any type of pneumatic process, was the relatively limited supply of blast furnace hot metal. No. 3 open hearth had operated efficiently with a hot metal charge of 40 per cent. It was therefore possible to produce more ingot tons from the available hot metal with new open hearths.

Some limitations were necessarily placed on the expansion plans. The building design for the extension was held to the same spans and column centers. Heat size was limited to an average of 320 tons to conform with the capacities of the two existing ladle cranes. Beyond these basic limitations, the operators were given everything needed within reason. Close co-operation between the engineering dept. and the operating personnel made it possible to incorporate all the desired improvements in the new design. Our industrial engineering dept. conducted numerous studies and was very helpful in justifying the additional major equipment needed.

As in any open hearth, the major problem to be considered was material handling. The primary bottleneck in the original shop was the hot metal handling station. This consisted of a single scale and pouring pit located outside the building. Metal was received in mixer-type cars and poured directly into transfer ladles. A cable-operated car moved the metal along a trench to a hatch under the charging floor where it was elevated by the hot metal crane. This arrangement permitted the handling of only 3.2 ladles or 320 tons an hr under ideal conditions. The addition of a second hot metal crane would do very little to improve the situation as the single hatch was the limiting factor.

Once it was established that additional metal handling facilities were needed, preliminary layouts were made of a second hot metal station on the extreme north end of the shop. Operators objected to this proposal because of the extra personnel that would be required to man two separate installations. Travel distance for the hot metal cranes would be too great if all the facilities were located at one end of the shop.

Engineering then developed a proposal to abandon the existing hot metal trench and install a new trench on each side. Each trench was to be equipped with a scale, and centers were set so that two ladles could be poured or elevated simultaneously. A crane could set an empty ladle on one transfer car and then bridge over to pick up a load. This scheme was adopted and installed in the area shown in Figure 1.

Load cells and electronic weighing were utilized for the two scales. These were installed in the track so that total weight of the blast furnace mixer cars is taken. This arrangement eliminates all scale mechanism in the pouring pit with the attendant danger of damage by spills. In our case, the more shallow pouring pit saved a considerable construction cost because it could be installed above the water table. The electronic weighing has been very satisfactory, and the accuracy has been excellent. Metal delivery capacity to the floor has been quadrupled with this installation plus an additional hot metal crane.

Handling of refractories and alloys from the ground to floor level had been accomplished by means of a 20,000-lb capacity hydraulic elevator located by the hot metal hatch. This method of floor supply had been so satisfactory that the operators rejected the idea of a ramp for this purpose. A second elevator of 50,000-lb capacity was installed in the north end of the shop.

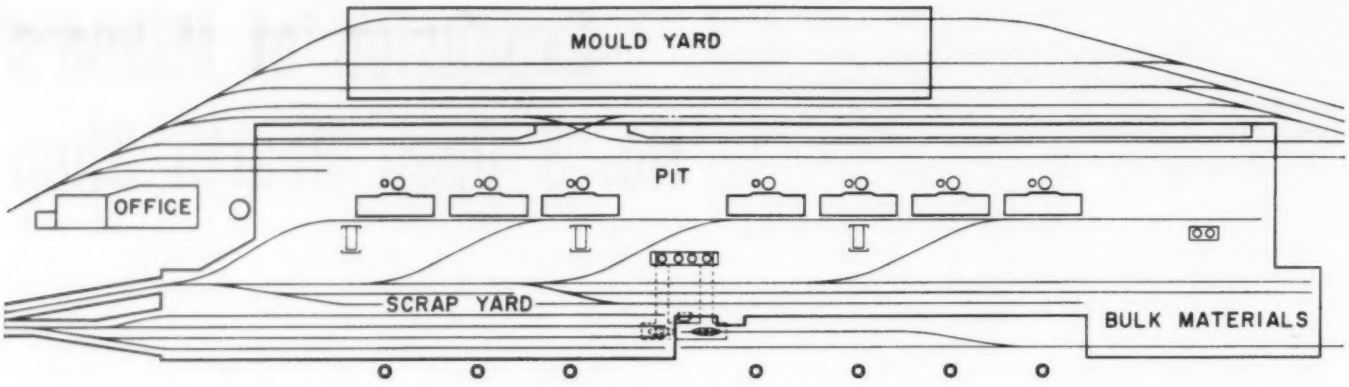


Figure 1 — Extended shop has seven furnaces.

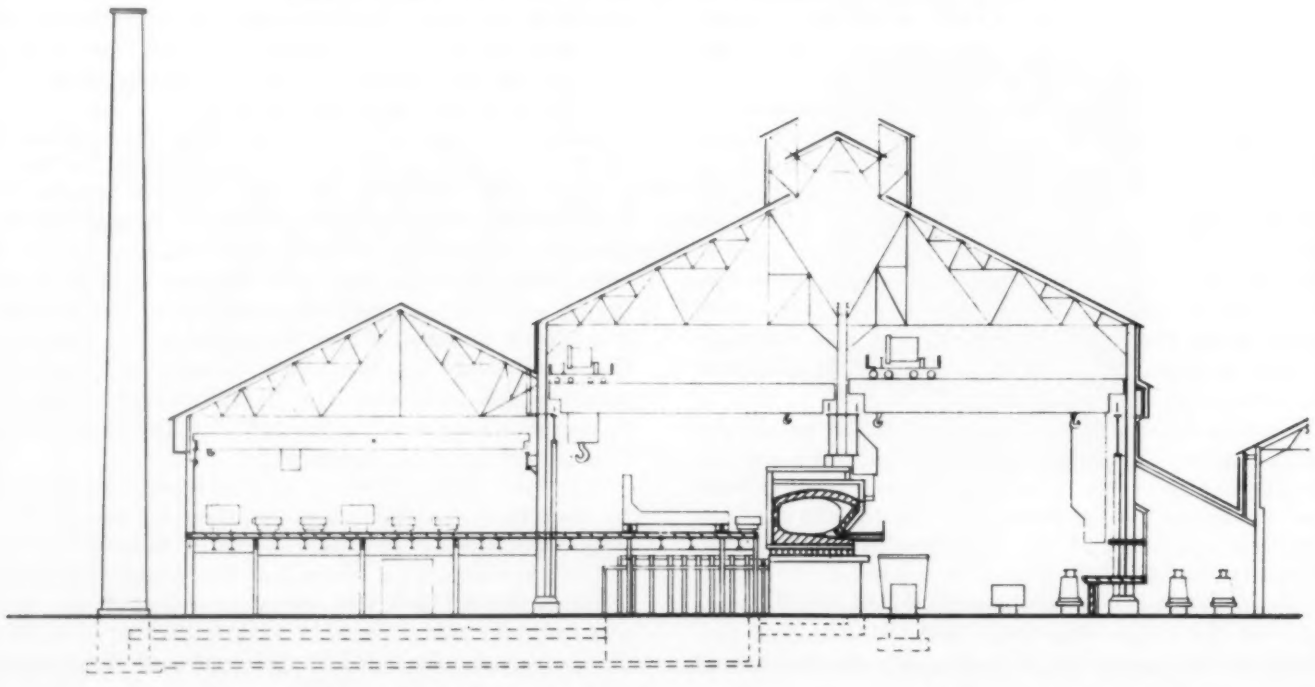
This cable elevator has a deck large enough to accommodate a large highway trailer. Two doors at basement level permit driving straight through the elevator or loading from inside or outside the building. In actual practice it has been found desirable to load pallets on the elevator with fork lift trucks and unload at floor level with other equipment. This obviates the necessity of keeping large areas of valuable floor space open to maneuver highway tractors and trailers. The fact that incoming trucks can be driven the full length of the basement permits rapid unloading and storage at any desired location.

Scrap loading and charging is of paramount importance to a shop expected to operate with a relatively low percentage of hot metal. Figure 1 shows the layout of the floor level scrap yard. This building was initially 504 ft-6 in. in length with a span of 95 ft-3 in. Settings of approximately eight railroad cars could be handled on each of the two unloading tracks. The center pan car tracks were equipped with an elevated working platform for stocking scrap. Because of the larger heat size and the added furnaces, it was decided to lengthen the scrap yard by 112 ft so that ten-car settings could be accommodated. A third 15-ton magnet crane was installed.

Relatively few alterations had to be made to the charging floor layout. An additional crossover was installed to service the three new furnaces. Adequate tailspace for charging the last furnace was provided in the two additional building bays to the north. Hot metal ladle relining pits and brick storage facilities were also located in this area. The importance of adequate storage space for large furnaces cannot be overemphasized. A rebuild job will consume from 40 to 80 carloads of refractories. If this material cannot be stored in the shop, valuable furnace time may be lost in waiting for scheduled shipments to arrive. This can result in excessive profit losses during periods of high tonnage demand. The efficiency and elapsed time of rebuilding can be greatly improved if proper storage and organization of material is possible.

Two methods of material handling that were incorporated in the original shop are worthy of mention. Roasted dolomite is dumped at ground level by the supplier's trucks. It is then elevated by an automatic skip hoist to a 500-ton capacity overhead storage bin. A discharge spout to the floor fills the dolomite guns or transfer boxes. Ferromanganese is unloaded by pit

Figure 2 — Shop cross section illustrates materials handling equipment.



crane buckets and then dumped into storage bins behind each furnace. An individual scale behind each furnace permits weighing at that location. Both of these arrangements have resulted in low cost and efficient handling of the two commodities.

A third charging car completed the major additions to floor equipment. Extra pan cars, charging boxes, pan stands, hot metal ladles and spouts were needed to support the increased tonnage.

Under the four-furnace arrangement, bulk materials were loaded into pan cars by power shovel at ground level. This involved numerous engine movements up and down the highline, and also diverted a substantial percentage of the available rolling stock. The new bulk material handling building is shown in Figure 1. Pan car loading is accomplished at floor elevation as in the case of the scrap yard. An electronic scale was provided for weighing the material at the north end of the shop. Dumping into the various bins at ground level may be by truck, side-dump car, or bottom-dump car. Loading is accomplished by a bucket crane.

The principal problem in expanding the pit involved the necessary pouring stand space. The original building had one pouring stand long enough to accommodate two heats. One bay, 112-ft long, had been provided for a future track entrance. Since a third ladle crane was to be added provision had to be made for the pouring of three heats simultaneously. Lengths of trains to be handled was determined through a study of all possible mold sizes that could be used with the new rolling mills. This study determined the over-all length of the main building. It was necessary to add 560 ft to the existing structure in order to house the new furnaces and furnish adequate pouring space. Final design resulted in one single and one double pouring stand as shown in Figure 1.

As mentioned previously, it was decided to increase the heat size from 300 to 320 tons. The six original ladles were lengthened by 12 in. and four new ladles were purchased. The twin chains formerly used for dumping ladles were not strong enough for the job, and failures occurred with the 300-ton ladles. A single dumping clevis was installed on the ladles and a rather unique dumping hook was designed as shown in Figure 3. This hook looks cumbersome, but is much easier to handle than chains. The bale remains upright so that the crane hook can be engaged readily. We have had no trouble with failures.

The mold yard was lengthened and a second crane installed to handle the additional tonnage. An elevated platform for mold conditioning was placed in one end of the building with a track on both sides. Since the top of the stools is about five ft above the ties, a low platform for stool conditioning was installed in the other end of the building. This enables a man to work at a convenient level and do a better job safely.

Furnace over-all dimensions were fixed by building limitations. A length of 91 ft inside the buckstays and a corresponding width of 25 ft-7 in. were the maximum dimensions consistent with proper clearances around the furnaces. The principal question to be settled was whether the furnaces should be equipped with single or double uptakes.

Of the original four furnaces, three were built with conventional main arches and double uptakes. The

Figure 3 — The use of a single dumping clevis has simplified ladle handling.

fourth furnace was of extended hearth, single-uptake construction. Our experience proved the single-uptake design to be far superior in performance.

Principal differences between the two furnaces are as follows:

	Double uptake	Single uptake
Charging doors	5	7
Uptake area (one end), sq ft	108.3	71.0
Hearth area (AISI), sq ft	1160	1320

Figure 4 — A few changes were made in dimensions of the newly installed open hearths.

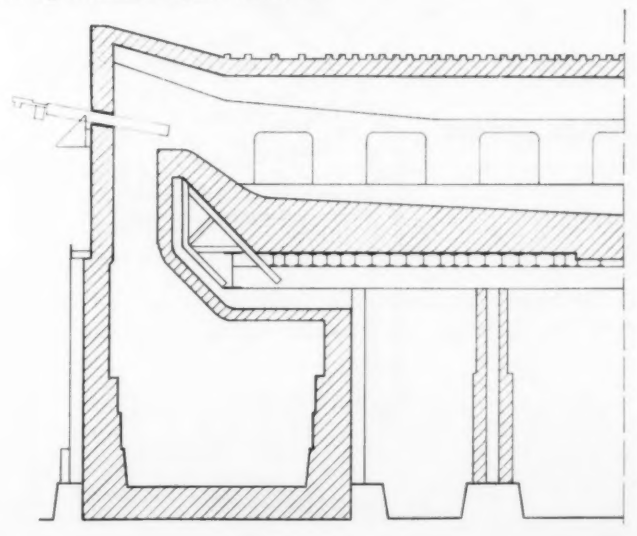


TABLE I

Year	Tons per hr, tap-to-tap			Gross, mm, Btu per ton		
	Single pass	Double pass	Per cent, Improvement	Single pass	Double pass	Per cent, Improvement
1954	25.68	26.31	2.5	3.577	3.387	5.3
1955	27.31	28.41	4.0	3.290	3.095	5.9
1956	29.61	30.82	4.1	3.155	2.961	6.2

The single-uptake furnace has consistently produced at a rate of approximately one ton per hour higher than the double-uptake units. During the first six months of 1959 the comparison was 31.2 tons per hr for the single-uptake against 30.0 for the three double-uptake furnaces. Firing rates and heat sizes were identical for all furnaces. We feel that the primary reason for this increased productivity is the shallow bath depth achieved with the greater hearth area.

Rebuilding is much simpler and cheaper with the single uptake. The silica arches on the original furnaces required two carloads of brick on each end. This tremendous volume of brick not only cost time and money to lay, but also accelerated build-up in the slag pockets. As a result, the single-uptake furnace could be run 50 to 100 heats longer before it was necessary to remove slag.

Figure 4 shows the longitudinal cross section of the new furnaces. A few changes had been made during operation of the original furnaces. The roof rise was increased from 36 to 42 in., and the skewback channels were raised 6 in. On the new furnaces, the binding was raised 12 in. to provide more flexibility in roof line. The advent of the basic arched roof has made this change very desirable.

Suspended basic port roofs were installed on the new furnaces. These have been slightly superior to the silica ports in life and cost. There has been no noticeable difference in the characteristics of the slag pocket deposits on these furnaces.

Major changes were made to the regenerative system of the new furnaces. A decision to install two-pass checkers was made after years of experimentation. In an effort to evaluate double-pass checkers, two of the four original furnaces were built with this design. The other two furnaces had single settings. Over-all binding dimensions and volume available were identical on the four furnaces. Extreme refractory damage was encountered in the hot-pass sections of the two-pass furnaces. As a result, one of these furnaces was converted to single pass after the completion of a 408-heat campaign. In view of the greater thermal efficiency of the two-pass arrangement, it was decided to retain this design in No. 40 furnace and make every effort to achieve successful operation.

A carefully selected crew of first helpers was assigned to No. 40 furnace. Various firing practices were set up and rigidly maintained until the effect could be determined. Maintenance of top checker temperature limits and resultant damage to refractories were watched closely. Continuous improvement in productivity, fuel consumption and refractory damage was achieved. The cost of keeping the checkers and flues cleaned was excessive until chimney-type checkers were substituted for the open setting and improved soot blowers were installed.

In our particular case, the solution to double-pass checkers was to carry high furnace pressure and utilize much greater percentages of excess air for combustion. We now feel that we can operate double-pass

Figure 5 — The installation of new checkers helped make possible a 50 per cent increase in firing rate.

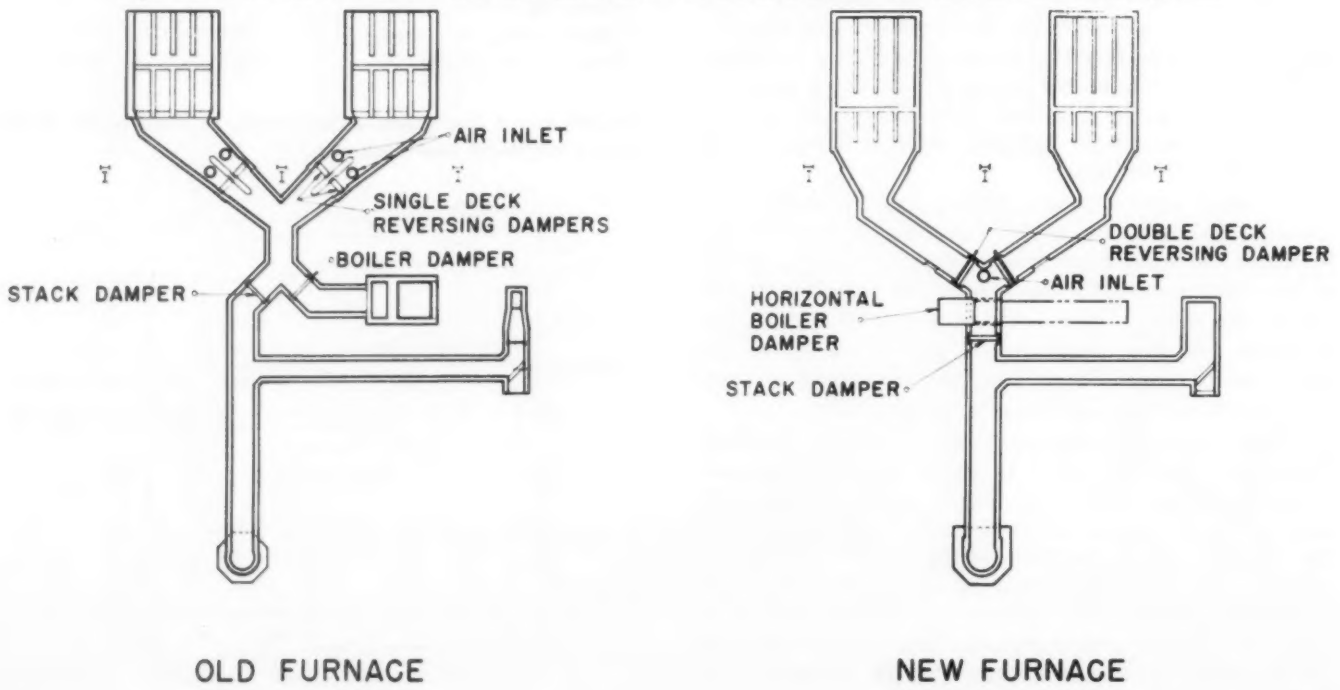


TABLE II

	Old furnace, 120 mm Btu	New furnace, 180 mm Btu
Waste gas volume (2600 F) cfs	2320	3310
Hot-pass horizontal free area sq ft	206	336
Hot-pass velocity fps	11.25	9.85
Blind-pass area sq ft	69	79
Blind-pass velocity fps	20.5	26.9
Cold-pass horizontal free area sq ft	144	137
Cold-pass velocity fps	10.8	16.0

checkers with no more refractory damage than is encountered with single pass.

The results upon which we based our decision to make this shop all two-pass checkers are summarized in Table I.

Six of the seven furnaces are now equipped with two-pass checkers. The seventh furnace will be converted when the checkers need replacement.

The original furnaces had a maximum firing rate of 120,000,000 Btu per hr. The new furnaces were designed to handle up to 180,000,000 Btu per hr. In order to accomplish this, it was necessary to revise the entire checker and flue system as shown in Figure 5. A comparison of the design characteristics of the two furnaces is given in Table II.

The new furnace checkers are 10 ft longer than the original design. Double-deck dampers were installed on the boiler side of the basement passageway. This arrangement eliminated an air-butterfly valve which had been a source of trouble in addition to freeing the necessary area for the longer checker chambers. Tunnels were increased in cross section from 52.3 to 63.6 sq ft in area. A greatly improved soot blower system was extended to the boiler damper where the gases make a right-angle turn and go up into the boiler. These soot blowers have been very effective in keeping the tunnels clean.

The forced-air fan capacity was increased from 30,000 to 50,000 cfm. Induced-draft fan capacity was doubled from 60,000 to 120,000 cfm. Waste heat boilers were enlarged from 25,000 lb per hr to 57,000 lb per hr. Stack diameter was raised from 7 ft-6 in. to 8 ft-6 in.

The new furnaces have performed well in comparison with their older neighbors. With all furnaces charging 320-ton heats, production for the first half of 1959 was as given in Table III.

We feel that considerable improvement in the productivity of No. 3 open hearth shop will materialize. The prospects of more hot metal will greatly alleviate the scrap charging problems which consitute a limiting factor at present. Results with the basic roof have been very encouraging. Preliminary work with a continuous oxygen analyzer indicates an improvement in furnace operation through use of that equipment.

It is obvious that oxygen furnaces will gain tremendously as a means of ingot production in the next few years. It is equally obvious that the open hearth furnace will not fade out of the picture overnight. There is much work to be done in improving the efficiency of the millions of dollars worth of units now in operation. The extent to which that efficiency will be increased may be much greater than we can now visualize.

TABLE III

	Tons per hr, Tap-to-Tap	Per cent Improvement
Old furnaces, silica roof	30.29	0
New furnaces, silica roof	32.54	7.4
New furnace, basic roof	35.20	16.2

Discussion

PRESENTED BY

ROBERT J. CONKLIN,
General Foreman—Open Hearth,
Wheeling Steel Corp.,
Steubenville, Ohio

W. P. McCABE, Chief Engineer,
Swindell-Dressler Corp.,
Pittsburgh, Pa.

R. G. PHELPS,
Manager, Steel Production,
Indiana Harbor Works, Inland Steel Co.,
East Chicago, Ind.

R. J. McCURDY, Superintendent,
Tilting and Electrical Furnaces,
Republic Steel Corp., Chicago, Ill.

Robert J. Conklin: Mr. Phelps has most aptly defined the basic objective of a good open hearth organization when he stated "There must be a continuing drive for lower costs and increased productivity." Obviously increased production is limited to several basic procedures:

1. Increased number of furnaces.
2. Increased furnace capacity.
3. "Make it faster."

The open hearth dept. at Wheeling Steel's Steubenville Works, as many of the older shops, has already progressed through various phases of expansion. We have reached the physical limits of both number of furnaces and heat sizes, therefore, we are forced to increase tons per hour through improved methods and efficiency.

This has been accomplished in the recent past by such things as:

1. Revised teeming platforms in the pit so that four instead of three heats can be handled simultaneously.
2. Installation of a fourth scrap charging machine.
3. Realining the supervisory force.
4. More uniformity in hot metal charge through improved blast furnace operation and metal specifications.
5. Standardized ore charge rather than a combination of ore and sinter.

Also in the engineering experimental planning or study phase to further increase production are such items as:

1. Best basic roof and/or furnace design.
2. Burner design and firing rates.
3. Air preheat
4. Ground flush practice.

5. Scrap preparation and delivery.
6. Material handling for both raw and rebuild materials.

This continuous "operation boot-strap" has resulted in an increase of tons per hr from 19.9 in 1957 to our present record of 21.11 tons per hr for May of this year. Our present "bogy" is 22.6 tons per hr and, of course, as with others there is no upper limit.

I would like to add that the necessity for both increased production and reduced costs was never more urgent to the open hearth operator than right now. The greatest effective challenge to date to the open hearth process is that which is presently springing from the new steelmaking processes recently developed. The status of the open hearth may well depend upon an even greater increase in production now than has been accomplished since its inception.

W. P. McCabe: Both Mr. Phelps and Inland Steel are to be congratulated on the performance of their new No. 3 open hearth shop. The increased capacity of the furnaces and the improved utilization of the gross Btu per ton is noteworthy. Also Inland should be congratulated on their tenacity in trying to make the two-pass checker system a good operation. This tenacity paid off in better furnace production.

We note that the waste heat boilers were enlarged from 25,000 to 50,000 lb per hr although not mentioned in the paper, but since we are the engineers for this project, we know these boilers are equipped with auxiliary firing units.

We would like Mr. Phelps' comments on the performance of these auxiliary firing units.

R. G. Phelps: The underfiring with bunker "C" oil tapped from the regular open hearth supply line may be accomplished either with the furnace down for repairs or with the furnace in production. With the furnace down and firing 160 gphr of oil, the boilers have made about 15,000 lb of steam per hr at 225-psi drum pressure. The unit was designed for 25,000 lb per hr but has never been run at full capacity. With the furnace in operation it is a little harder to determine exactly how much steam is being generated by the underfiring. It is somewhere between 10,000 to 15,000 lb per hr, once again firing some 160 gphr of fuel oil into the boiler.

R. J. McCurdy: Many of the installations at Inland Steel are of special interest to our shop. Their new electronic weighing system for hot metal with its attendant accuracy and reduced maintenance from spills, is one such installation. Has there been any noticeable effect on yield with this bottle weighing method? The scrap stocking and stool cleaning platforms are another interesting innovation. Has damage and maintenance become a problem? In the new furnaces, is the 2.7 tons per hr superiority of the basic roof over the silica roof due to higher firing rates or oxygen lances? Has roof life improved since the increased roof rise and skewback elevations were completed? Is special brick used in the hot-pass on two-pass checker installations? What benefits are obtained with ten additional ft in length of checker chambers on the new furnaces? How are checkers cleaned during operations? Mr. Phelps has mentioned "improved soot blowers." What steam pressure is used on this system? Are tunnels cleaned separately or all at one time?

R. G. Phelps: With the electronic weighing system for hot metal and the bottle-weighing method, there was a noticeable increase in yield, which was around 0.3 to 0.5 per cent. There was a slight decrease in blast furnace yield at the same time. Actually, we do feel we get more accurate weighing with that setup because it is capable of being tested. It is a track scale and we can run a test car on the scale very easily for checking purposes.

In the case of a scale located down in the pit, it is quite a problem to maintain a satisfactory test weight for checking.

The scrap stocking and stool cleaning platforms do require considerable maintenance. They are constructed in sections between 20 and 30 ft long depending on the size and location and are normally made from piling bar or from heavy ship channels. The platform is filled with crushed slag and then surfaced with six to eight in. of concrete. This construction can be patched easily if broken by a mold or heavy scrap.

The steel work for a scrap yard walkway will have to be replaced about every five years if your experience is the same as ours. We do feel the installations are well worth while because they are a lot safer for the mold cleaner or stocker. He is up where he can do his job more efficiently and safely.

Mr. McCurdy asked whether the 2.7 tons per hr superiority of the basic roof over the silica roof was due to higher firing rates. Increased firing rates and greater usage of decarburizing oxygen were both involved.

We had a definite improvement in roof life from the increased roof rise on silica furnaces. Raising the skewback also increased life. However, it was primarily associated with fewer punches by the charging car. The charging car operator had a little better clearance over his door frame opening.

It is difficult to measure the results because during the same time we were making other changes in roof design and firing practice. We do feel both changes benefited us somewhat, but I cannot give you an exact measurement of their value.

We do use a super-duty fire clay brick on at least the top six courses of our hot-pass checkers.

On benefits obtained with ten additional feet in length of checker chambers, about all I can say is the new furnaces are operating satisfactorily and we can boost the firing rate. The furnace does not blow. It handles the flow of gases adequately. I do not believe there is any good information available on checker design. There is a committee of the AISE that is working on this problem with Columbia University. Let us hope we get some good design factors for open hearth checkers from that study. All I can say is the furnaces are working well. We think we guessed about right on the 10-ft increase in length.

The checkers are blown with a steam lance using 225-psi pressure during operation. One row of blow-out holes at the top of the checkers is used. The soot blower uses 225-psi steam pressure.

The tunnels are cleaned in sequence. We start with the blowers close to the stack then progressively activate blowers back toward the checker chamber. When we have traversed the whole pattern we reverse and go back one at a time in the opposite direction. Tunnels are blown twice a week. ▲

The Use of Oil Film Bearings On A 12-In. Merchant Mill

by H. S. BALDWIN, General Foreman
12-In. Merchant Mill, Sheffield Div., Armco Steel Corp., Kansas City, Mo.

. . . . proper lubrication and maintenance show results in long life and low overall maintenance cost for oil-film bearings on a 12-in., 15-stand merchant mill . . . .

THE 12-in. mill at our plant is a fifteen-stand merchant mill consisting of twelve horizontal and three vertical roll housings (Figure 1). All horizontal stands are equipped with oil-film bearings. The No. 3 vertical edger is supplied with lubricating oil but is designed with fixed internal roller bearings. No. 1 and No. 2 edgers use fabric bearings which are water lubricated. The vertical edging stands are used only on flats and angles. The first eight stands and three edgers are in line. The bar is then repeated back through No. 9 stand and again through No. 10 stand. The finishing train consists of stands No. 10, 11 and 12. All three finishing housings are used solely for rolling rounds $\frac{7}{16}$ through $\frac{47}{64}$ in. All other products are finished out of No. 10 stand and may be delivered to the hot bed or into a pair of pouring reels adjacent to the mill runout table. The maximum finishing speed is 1850 fpm and is attained on the small rounds.

RANGE OF PRODUCTS

The sizes rolled on this mill are as follows: rounds $\frac{7}{16}$ through 2 in. as well as No. 18 reinforcing bar; $1\frac{1}{4}$ and $1\frac{1}{2}$ in. round cornered squares; 3 in. x 4.1 lb and 4-in. x 5.4 lb channel; $1\frac{1}{2}$ x $\frac{3}{16}$ to 6 x $\frac{3}{4}$-in. flats and angles from $1\frac{1}{2}$ x $1\frac{1}{2}$ x $\frac{3}{16}$ through 4 x 4 x $\frac{1}{2}$-in.

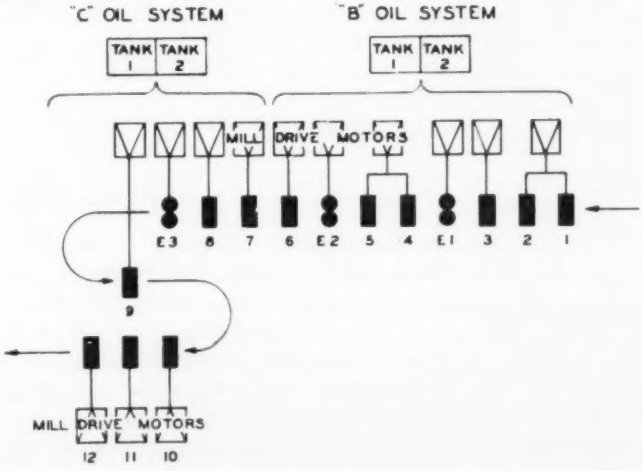
BEARING COMPLEMENT

The complete bearing inventory is twenty-eight sets (112 bearings). Seven sets (28 bearings) are of the 16-in. size and are used on the first three stands. The rolls for stands No. 1, 2, and 3 are changed in the mill since no spare housings are available. Twenty-one sets (84 bearings) are of the 12-in. size and are used on stands No. 4 through No. 12. There is a spare housing for each one of these stands. Eleven bearing sets are used on stands No. 4, 5, 6, 9 and 11. Ten sets have the work side bearing casings padded to compensate for widened roll housing windows. Stands No. 7, 8, 10 and 12 were revamped in this manner in order to accommodate larger rolls. All bearings may be interchanged wherever size and padding permits.

SUPPLEMENTARY PIPING AND EQUIPMENT

Oil is supplied to the bearing in the mill by means of a central header piped to each stand. The oil enters the

Figure 1 — Schematic shows mill layout and lubrication system.



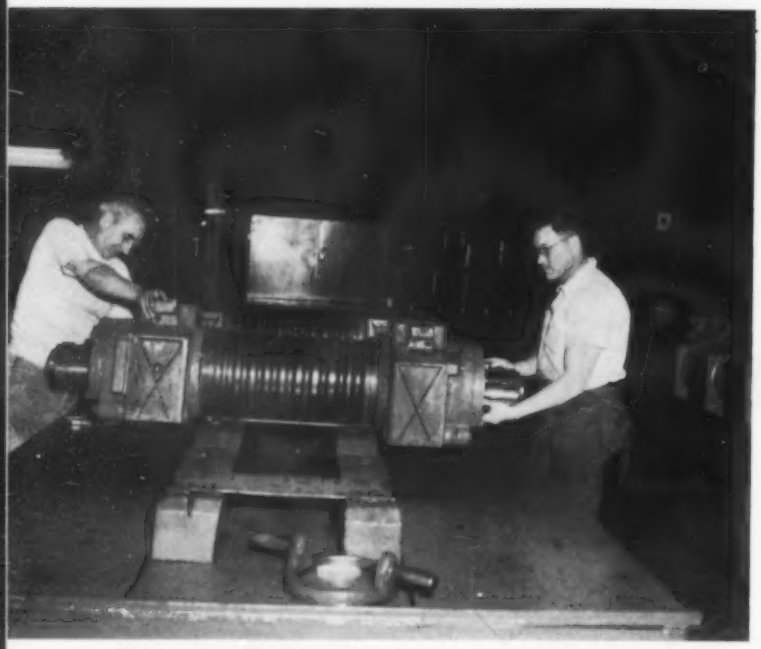


Figure 2 — Bearing repairmen remove bearings from a roll prior to an inspection.

top side of the bearing through a metering orifice under a pressure of 15 psi. The pressure at the oil supply reservoir is 40 psi. The oil flows through the bearing and drains by gravity back to the oil cellar. The oil is recirculated to maintain continuous oil film protection for the bearings. The inlet oil line is 1½-in. standard pipe while the return line is 2½-in. standard pipe. Drive unions are used to connect the oil feed and return hoses to the fixed stand piping. These hoses are used since the roll stands are movable and can be taken out when desired. Flexible lines are used to join the bearing inlet and outlet to this same piping. The advantage of the different size feed and return lines is that no crossing of these lines is possible. The drive fittings require only a hammer to connect and disconnect the oil lines. Lugs are welded behind the female half of the union to prevent their sliding down the hose when the union is parted.

A series of red warning lights are used along one wall of the mill and are clearly visible from the mill control pulpit. These lights are normally off and are lit when insufficient pressure is present at any given stand. The lights are activated by an oil pressure switch whose supply line is tapped off the flexible hose which connects the piping on each individual stand to the main supply header. These warning lights enable the maintenance people to isolate the trouble quickly. The pressure gages are kept away from the mill to prevent their damage during mill changes.

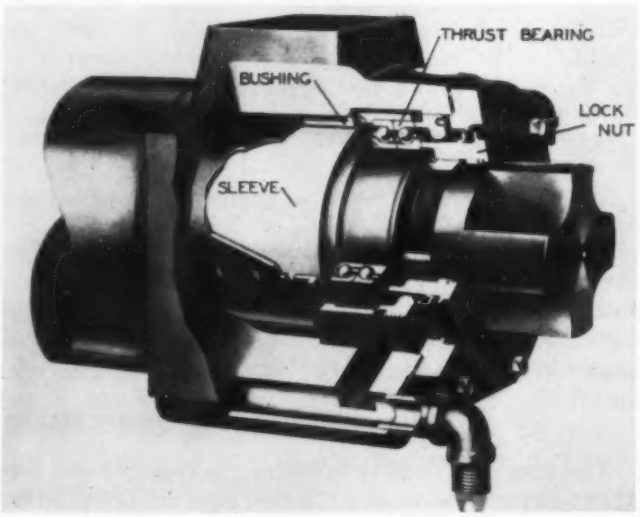
BEARING SHOP

Two men operate the bearing shop and work the daylight turn only. These men maintain all bearings and remove and install them on rolls selected by the roller. Two roll build up benches are used as seen in Figure 2. The bearings are first cleaned over sisal paper and then placed on the blocks with their keyways up. This facilitates easy removal and assembly of the bearings. The tables are equipped with drains to catch the oil.

The secret of success in using oil film bearings can be expressed in one word, *cleanliness*. Clean bearings will run prolonged periods of time with a minimum of maintenance. Bearing men have a most important part in this phase of bearing care. Most nonmoving parts of the bearing are painted in the bearing shop. Roll lacquer is used on the faces of the bearing housing that bear against the roll housing window. The remainder of the bearing casing, inside and out, is painted with oil resisting enamel. Lock rings, thrust bearing housing and exposed bolt heads are also painted with the same type enamel. The painted surfaces facilitate cleaning. As dirty as the bearings are when they come out of the mill, these painted surfaces may be scraped with a putty knife and wiped clean with solvent soaked rags. The ease and rapidity with which the bearings may be cleaned offsets the time and expense of painting.

Several quick checks have been developed by the bearing shop people to determine the condition of the bearings. When a used roll with bearings is placed on the floor the first check can be made. If an audible click is present when set down, they know that play exists between the bushing and sleeve. These bearings are given a close check when removed. When the roll is placed on the chocks, the drain lines are taken off and the oil allowed to drain on the table. Any foreign material such as bits of metal, water, rubber and scale can be easily detected by visual inspection. The presence of contaminants will cause the bearing to be set aside for later dismantling and reconditioning. The screwdriver can reveal sources of trouble in a bearing that has been dismounted from the roll. Figure 3 is a section through the bearing. By prying axially between the sleeve and the bearing casing, small amounts of end play can be felt. By prying radially between the bearing casing and the sleeve, the amount of bushing wear can be determined. Since the ball bearings carry the thrust load, the bushing which carries the radial load is the primary point of wear in the oil-film bearing. Some wear is not detrimental, but the higher speed finishing stands should be kept as tight as practical in order to avoid roll bounce. The practice of moving worn bearings back toward the roughing mill has proved very satisfactory in the 12-in. mill. Here greater clear-

Figure 3 — Section through the bearing shows the component parts and their arrangement.



ances between the bushing and sleeve are less critical. When bushing wear is deemed excessive, the bearing may be used on the bottom of slower speed stands. By this means the original bearing clearances may be regained, and the life of the bushing is prolonged. Top roll bushing clearances are kept to a minimum since the bearings are suspended from carriers. Whenever bushings are replaced, they are installed in top roll bearings near the finishing end of the mill. When end play is too great, it may be removed by tightening the thrust adjusting ring.

When a bearing is judged to be in good operating condition (which is the case the majority of the time) it is given a superficial cleaning and transferred to another roll. Some of the bearings in the slow speed roughing stands have not been dismantled in eighteen months and are operating satisfactorily. The 12-in. bearings are reconditioned on an average of once every three months. Reconditioning consists of a thorough cleaning, replacing worn out seals, bearings, bushings and boots. Oil applied on the inside face of the lock nut lengthens the life of the outboard oil seal. All bearings are visually inspected as they are transferred from stand to stand. The boots and the outboard seals are the most frequently worn parts and may be changed readily without tearing down the bearing. The skill of the bearing shop men must be depended upon to keep the bearings in satisfactory operating condition. The teamwork of the bearing shop people in the 12-in. mill has enabled them, when pressed for time, to change a set of four bearings from one pair of rolls to another in six minutes. While this is not an everyday occurrence, it does indicate the degree of proficiency developed by these people.

MAINTENANCE OF THE OIL SYSTEMS

As is the case of cleanliness of the bearings so it is with the lubricating oil. A mineral oil of 1600 SSU at 100 F is used on the "B" system which provides oil for the bearings in roll stands No. 1 through 6, a mineral oil of 630 to 660 SSU at 100 F is used on the "C" system which supplies oil to the bearings in stands No. 7 through 12. The oil is circulated through the mill leaving the reservoir tanks at 120 F. Each system is operated using only one of its two tanks. The alternate tanks of the systems are switched onto the oil supply lines every other week. The idle tanks are reconditioned by removing dirt and water contaminates. The water is removed by holding the oil at an elevated temperature of 180 F for a period of four hours. This causes the water to precipitate to the bottom of the tank. Steam heaters are then shut off and a valve at the base of the tank is cracked open. When traces of oil are visible in the water, the valve is shut off. The oil is then passed through a centrifugal separator which removes the balance of the water. The clean oil is then returned to the storage tank. Solid particles are removed from the active system by disk type strainers.

TROUBLE SOURCES AND SOLUTIONS

As with any operation problems do arise. Small bits of metal appeared in the oil when the bearing casing was drained. These metallic pieces were found to be from the top edges of the keyways in the rolls. This condition was remedied by deepening the keyway as well as chamfering the keyway edges. The increased depth gives more bearing area for the key and the beveled edges relieves the stress concentration at the edge of the seat. In another case, foreign metal particles caused seizure of several bearings before the source was discovered. The deterioration of one of the disk type filters was found to be the cause. Before the source of the trouble had been determined, small screen type strainers were installed in the oil inlet piping on the roll stands. These filters prevented the stray metal fragments from entering the bearing until the system could be freed of the particles. No further bearing failures have been experienced since that time (approximately twelve months ago). If the oil system is functioning properly, the necessity for strainers on individual roll stands can be questioned. The extra precaution is worth the expense since it removes any impurities from the oil at the last practical point before entering the bearings. The opened systems caused by changing roll housings is also guarded by this strainer. An additional problem arose when the bearing oil supply was cut off causing a bearing to run hot and seize. This type of oil stoppage does not show on the warning lights since they are operated from pressure on the inlet side. Upon dismantling the bearing and stand oil piping, a small piece of rubber hose lining was found to have lodged in the orifice strangling the flow of oil to the bearing. This was remedied by closer inspection of the large feeder hoses between the supply header and the roll stand. These supply hoses are now changed once yearly. Loss of oil from the small hoses at the inlet and outlet ports of the bearing has been greatly reduced by an annual replacement. Obvious physical damage to either the large or the small hoses is repaired upon discovery. The close visual inspections and the yearly general replacement of the hoses has proved to be adequate protection from this type of failure.

Cold weather likewise presents out of the ordinary problems. Temperatures of 0 to 15 F are not uncommon for short periods in the winter season. When the mill is down over the weekend during these cold spells, the oil return lines become chilled. The warm oil starts through the mill and the cold pipes stiffen the oil sufficiently to cause overflow at the breather pipes on the roll stands. This condition can be alleviated to a certain extent by increasing the temperature of the oil at the reservoir to 180 F. Even with this increased temperature, oil reaches the bearing at no more than 110 F. As the system warms up and the oil drains back properly, the temperature can be dropped back to normal. Other alternatives are available. The oil in the systems can be circulated during the down period. The disadvantage of this method is that maintenance people must be present to tend the system. Another solution is to trace the oil return lines with a small steam line. This answer to the problem appears to be the most practical and its installation is anticipated as soon as sufficient time is available.

One of our most difficult problems occurred shortly after the mill was put into operation. The babbitt bearings on No. 1 and No. 2 edgers were oil lubricated but were of a different design than the ones used on the horizontal stands. Water and scale infiltrated the bab-

bitt bearings readily and caused excessive wear as well as great loss of oil. When efforts to seal this type bearing were of no avail, they were replaced with water-lubricated fabric bearings.

COSTS

The 12-in. merchant mill has been in operation since August, 1948, and the costs recorded in this article cover a ten-year period. Labor costs for the two men in the bearing shop has been $0.0538 per net ton. Oil costs for the bearing lubricating systems has been $0.0323 per net ton. Cost of replacement parts including seals and lock nuts has been $0.286 per net ton. Spare parts on hand are included in this cost. The total cost of labor, oil and parts for the oil film bearings to date has been $0.1147 per net ton.

ADVANTAGES OF OIL-FILM BEARINGS

The ability of the bearing to hold the roll in a desired position for a long period of time is its primary virtue. Small rounds are rolled within commercial tolerances and the only adjustment needed is for pass wear compensation. After steady drawing and under ideal conditions, rounds during a rolling have been found to be out of round only 0.004 or 0.005 in. However, heating and rolling practices present so many variables that this small tolerance is impossible to maintain for any great length of time.

Angles on the 12-in. mill are rolled on open passes. Even the unequal leg angles can be held to a minimum of variation well within commercial tolerances. The uniform thickness of angles rolled on these bearings facilitate accurate straightening within a minimum of effort.

Another advantage of the oil-film bearing is the small amount of torque required to start the mill from rest. The friction load is negligible. This is well illustrated by the ease in which a roll can be turned with a small wrench when coupling up the mill. This is in sharp contrast with fabric bearings which rely on tightness to hold the roll in position.

SUMMARY

The success of using oil-film bearings can be largely attributed to the personnel in our bearing shop. These men have taken great pride in keeping the shop and the bearings immaculate. After ten years, the bearings look as good as, if not better than, they did when they were uncrated. As was mentioned before, good maintenance is necessary for long trouble-free service from the bearings.

The combination of closed top housings and oil-film bearings have permitted rolls from a stand in our build up area to be removed and new ones installed in a matter of five minutes. The closed top housings are desirable from the safety standpoint, as well as for providing a rigid holder for the bearings.

As is seen from the ranges of sizes rolled on this mill the bearings are given a good workout. The confidence in this type bearing is best displayed by our company having ordered a 23 stand rod and merchant mill equipped with oil-film bearings and closed top housings.

Discussion

PRESENTED BY

T. A. MARSHALL, Lubrication Engineer, The Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada

SAMUEL CARSON, Field Engineer, Morgan Construction Co., Worcester, Mass.

H. S. BALDWIN, General Foreman, 12-in. Merchant Mill, Sheffield Div., Armco Steel Corp., Kansas City, Mo.

W. P. FULGINITI, General Foreman, No. 1 Rod Mill, Cuyahoga Works, American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio

A. E. CICHELLI, Lubrication Engineer, Construction Engineering Dept., Bethlehem Steel Co., Bethlehem, Pa.

T. A. Marshall: The paper deals with the advantages of oil-film bearings, such as low starting torque, close tolerances rolled, and the safety factor derived from closed top housings. It is evident that careful inspection and maintenance in the bearing shop is paying off. In dealing with oil-film bearings the very crux of your mill operation is in careful inspection and maintenance. This together with a properly maintained lubrication system supplying the correct oil to the bearings at temperatures and quantities designated by the manufacturer cannot help but result in increased production for the mill.

There are a few questions which I would like to inject into this discussion. First, what tolerances are required for new bearings when first installed? Second, how much wear is permitted before the bearing is transferred to a slower stand? Third, do closed top housings slow up roll changes perceptibly over the old type open top housings?

Mr. Baldwin has dealt at some length with trouble sources and solutions. I would assume that the filter which gave the trouble was equipped with copper disks. We went through a similar experience on one of our mills. However, I am in favor of the small screen type filter installed in the oil inlet piping on each roll stand. They will pay off regardless of the type of filtration used in the oil cellar.

Cold weather operation presents its problems. We have found that oil supply lines wrapped with heating cord and controlled by thermostat were more effective than steam and easier to maintain.

Water contamination must be dealt with and most oils will respond to heat, dropping moisture quite readily, provided the emulsion is not too stable. The use of an emulsion breaker will assist materially in dropping water and solids to the bottom of the tank without the use of excessive heat and will cut down on the amount of centrifuging necessary.

I notice on No. 1 and No. 2 edgers the author states it was necessary to change from babbitt to fabric bearings which are water-lubricated. Has any attempt been made to further lubricate this type of bearing when starting the mill? On our blooming mills as the mill goes down we pump very heavy oil into the bearing. This puts a good coating on the roll neck and pays off on start-ups.

Samuel Carson: The original tolerance is approximately 0.001 in. per in. diameter of the sleeve.

H. S. Baldwin: On the finishing mill we keep them tight. On the question, "How much wear is excessive," on the bottom bearing, you can handle $\frac{3}{64}$ in. without any trouble. On the top bearing by the time you get $\frac{1}{32}$ in. you better start moving it back to the lower speed stand.

The old rod mill that I have referred to was a 17-stand rod mill with open top housings. My personal opinion is the closed tops are more efficient and quicker than the open top. When you put the roll in, you have the bearings on the rolls and slide them into one end of the housing.

It is interesting to see how you compensated for the oil return with electric cord. On the No. 1 and No. 2 edgers, no further lubrication is tried except water. On the old rod mill, for down periods of any length of time, say several days, we would try to inject oil into the bearing. It is a little difficult to do in a close coupled mill, but it did aid in starting the mill. I can see on a larger mill where you can really get to the bearings with grease, that any sort of lubrication when going down will certainly help in starting up the mill. Water lubrication is quite adequate when the mill is running on the old rod mill.

W. P. Fulginiti: Since the author mentioned that his company is building a 23-stand rod and merchant mill equipped with oil-film bearings, it will be of interest to point out some of the details concerning the bearings in our 23-stand rod mill. The bearing inventory consists of a total 308 bearings: 60—18 in. bearings for No. 1 through No. 5 roughing stands, 48—16-in. bearings for the second roughing, 104—12-in. bearings for the intermediate mill, and 96—11-in. finishing mill bearings.

The bearing station is operated by one man per turn and is located in the roll shop adjacent to the rod mill. It is supervised and maintained by the operating department.

All the bearings are dismantled, cleaned, inspected and assembled in an area which is free from rolling mill dust to insure the best results. Normally the bearings are stripped from the rolls, visually checked, cleaned and replaced on new rolls. To maintain an efficient quality mill, the finishing mill bearings are throughly inspected every 60,000 tons, the intermediate mill bearings after 80,000 tons and when 100,000 tons have been rolled over the roughing mill.

A noticeable increase in roll bounce was observed after the 6000-fpm finishing mill heated up while rolling steel. It was concluded that the aluminum bushings expanded more than the steel sleeves when the bearing temperature increased causing excessive oil clearance. To minimize the roll bounce and reduce oil clearance, the aluminum bushings were replaced by steel backed babbitt bushings and the viscosity of the oil was increased from 200 to 400 SSU at 100 F.

Scale and water mixed with the oil when a cobble burned the bearing boots. This hazard was eliminated by installing steel straps over the neoprene boots on the bottom bearings from No. 6 through No. 23 stands. In the first roughing, the neoprene boots were replaced with an asbestos-fiber glass composition that resists burning.

Since the rod mill is just a little over three years old and for the first two years a working inventory of parts and equipment was purchased for the bearing station, we will compare cost figures for the last 12 months of operation only. This shows a close comparison with those quoted by Mr. Baldwin.

Even though oil-film bearings require proper maintenance for maximum efficiency, they are not fragile pieces of equipment and will take a lot of abuse provided the oil film is maintained and that foreign particles are kept out of the oil system.

While the operating problems were being worked out of our new rod mill, the bearings received some very rough treatment without excessive failure. Tight inspection schedules were set to help expedite mill progress, but the inspection statistics presently being accumulated, strongly indicate that the major overhaul time can be increased without effecting mill operating efficiency.

H. S. Baldwin: It is interesting to see a mill that is a little different. I forgot to point out that the oil costs on our mill are not from what oil the bearings use. They are from what we lose by broken hoses and malfunctioning of our oil systems. Upon separating lines, the oil, if the millwright does not watch it carefully, will be lost. We have had this happen. These facts contribute to oil costs. Oil usage by the bearing is nil.

Samuel Carson: It is my privilege to know the bearing men, the men who are responsible for the bearing performance on the mill described by Mr. Baldwin. These bearing men have developed their own techniques for handling the bearings and neither the passage of time nor familiarity with the job allowed carelessness to creep into their maintenance practices.

When the mill was planned a lot of thought was given to the bearing shop, its location, size and facilities. The area set aside for bearing maintenance is often greatly reduced as installation of the mill progresses and some part of the production line, which was overlooked, requires area. This was not the case in this installation.

A. E. Cichelli: Are your bearings babbitt or aluminum?

H. S. Baldwin: The ones I have are aluminum. The ones on the mill in Cuyahoga are steel babbitt bearings.

A. E. Cichelli: Our experience with aluminum bearings has not been gained in the same type of mill that you have although it appears throughout the industry that the handling and treatment of aluminum bearings requires a reassessment of our bearing lubrication program.

With babbitt as a bearing material, we were able to operate with a less demanding practice as far as lubrication was concerned than has been found to be the case with the aluminum bearings. Particularly, oil filtration has to be far more efficient.

Because aluminum does not have the "embeddability" properties of babbitt, filtration has become the important factor. Anything that will get through the filter to lodge itself in the aluminum is the beginning of trouble.

As for screen vs disk filtration we have had trouble with each type. However, a recent experience with the screen type pointed up the difference in the lubri-

cation of babbitt vs aluminum bearings. What had been "satisfactory" filtration for babbitt bearings was unsatisfactory for the aluminum.

Unfortunately, the manufacturers of our screen type filters did not do a good job in soldering the screens and the solder broke. Apparently, this trouble was with us long before it was discovered, as we found it to be prevalent in quite a few operating systems. Though our screens were inefficient, we suffered no serious damage or failures in our babbitt bearing installations; however, the high incidence of aluminum bearing failures led us to find the difficulty. Screen types are vulnerable also and aluminum bearing installations are especially sensitive to filtration failures.

The reason oil-film bearings give such a low friction horsepower is, of course, due to the thin film of oil on which the journal is floating. One aspect of this, that is little realized, is how thin that film really is. It can be calculated and even measured, electrically.

We learned that the film thickness on which these rolls were supported was considerably less than the particle sizes that the filters allowed through their openings. For example, a 0.005 in. filter is going to allow particles through that are larger than the film thickness that you are depending on for lubrication. That does not mean that you are going to have immediate bearing failure, but it does mean that you are going to wear the softer metal away much faster. Theoretically, proper filtration should reduce particle size to considerably less than 0.005 in. to prolong bearing life. Our more recent filter installations combine our screen filters with a magnet. This has helped.

What is your experience with bearing oil water content? Your reply would indicate efficiency of the seal design.

There is always a question as to the differences in the power loss or the friction horsepower of oil-film bearing vs phenolic water-lubricated bearings. Years ago, when phenolic bearings first came into the industry, the principal reason that they were accepted was the savings in power gained over grease-lubricated bearings. Those of us who have used phenolic bearings can testify to the justification of this claim. We also know the oil-film bearing has a low friction horsepower loss. But I would like an expression as to the difference between these two type bearings, in a mill such as this one. How much power do we save with either bearing? I believe you stated you have another mill with phenolic bearings. Perhaps you can venture an answer.

H. S. Baldwin: We have just changed to the steel backed babbitt type of bushing in our reordering of replacement parts. As you stated Mr. Cichelli, the aluminum bushings do pick up more readily than the other type bushings.

We had an interesting problem very recently that was caused from a backlash on the mill. That is the only thing to which we can attribute a bearing failure. Bearing people do not agree with me on it. The holes that hold the bearing became slotted out by a whip in the mill. The process caused a little particle of aluminum to become trapped in the bearing and picked up. It was a brand new bearing having been in use five hours. The bearing was clean, the oil was in good shape, the strainer was clean—ideal conditions and the bearing went out. We feel this was caused by the increased wear in the wabbler pods. I am in agreement with you, I like the metal back bushing with the babbitt lining.

About the per cent of water in the oil, I do not have that figure. After separation the oil is clear and the milky appearance of the oil is gone.

I cannot tell you the percentage saved on horsepower. ▲

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Dynamic Management For Profit

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by A. E. McDONOUGH,
Division Superintendent
Blast Furnaces
and G. H. KRAPF,
Division Superintendent
Power Production
South Works,
United States Steel Corp.,
Chicago, Ill.

TO run a profitable mill, under conditions of limitde demand, is largely a matter of controlling costs. It is obvious that one cannot sell his product for more than any other mill's product, and that the price, in the long run, is set by the lowest cost producer in the field.

To reduce costs then is the prime duty of any operator who takes seriously his obligations to employees, stockholders and his ultimate boss, the consumer.

A steel mill is made up of many areas of responsibility, and in an integrated mill, the actions taken to reduce cost, must be integrated as well. Here is where varying opinions develop.

Rolling mills are always ready to cut their costs by improving yields, providing the open hearths supply every ingot 10 per cent overpoured.

The open hearths are eager to reduce their conversion costs by shaving another 10 to 15 min off the tap-to-tap time provided, of course, that the blast furnaces supply them with casts which never exceed 0.020 per cent sulphur.

The blast furnaces will cut money off the cost of pig iron, provided they get lower ash, lower sulphur and lower moisture coke. The power production people can supply cheaper power to all concerned if only the blast furnaces will commit themselves to deliver 100 per cent clean gas with a Btu content of not less than 200 to the cu ft. By this time, each division has reduced its cost by 25 per cent. Somehow the cost of the finished product has gone up 50 per cent in the process.

You do not have to be a genius to realize that under ideal conditions, any one unit of the plant can do a stand out job by itself. However, the sad fact is that one must always compromise economic needs with the economic needs of co-managers. Without such a compromise, no progress is possible. Agreeing that costs must be reduced, and that co-operation between managers is necessary, the only problem is, achievement of co-operation for cost reduction.

At South Works, we have one approach, which is certainly not the only approach. It may not be the best approach, but it has worked, and is working for us.

In the hope that what we have done will stimulate others to do better, so that we in turn can learn from them, we are presenting a case history in achieving co-operation and some of the results.

Blast furnaces and power production in an integrated steel mill are closely intertwined operations. In some steel mills they are the same department.

At South Works they are separate divisions, each with its own division head, its own equipment, areas of responsibility and its own well defined functions.

The blast furnace division is comprised of 11 blast furnaces, with about 12,000 tons of iron per day capacity, two vessel docks with unloading and ore yard equipment, one flue dust sintering plant, one ore sintering plant, a pig machine and a ladle house, together with other miscellaneous auxiliaries.

The power production division has four turbine generators, nine gas engine generators, capable of delivering 86,135,000 kwhr per month and six blowing engines and seven turboblowers capable of delivering 977,000 cfm, besides supplying steam, compressed air, water, oxygen, natural gas and fuel oil, to the whole mill. It operates ten motor rooms, three power stations, associated substations and transmission and distribution systems.

Figure 1 shows the physical layout of the two divisions—with blast furnace equipment and the power equipment heavily outlined.

To emphasize the interdependence of these units, for those who may not be intimately familiar with the operations, we will point out some of their activities.

The power division supplies wind and utilities to the furnaces, which amounts to a significant proportion of the conversion cost of iron.

The cost of blast air and electric power in turn, is partly determined by the cost of blast furnace gas to the power division. Incidentally, most of all the energy consumed in the power-making process at South Works comes from blast furnace gas.

The instrumentation which enables the blast furnaces

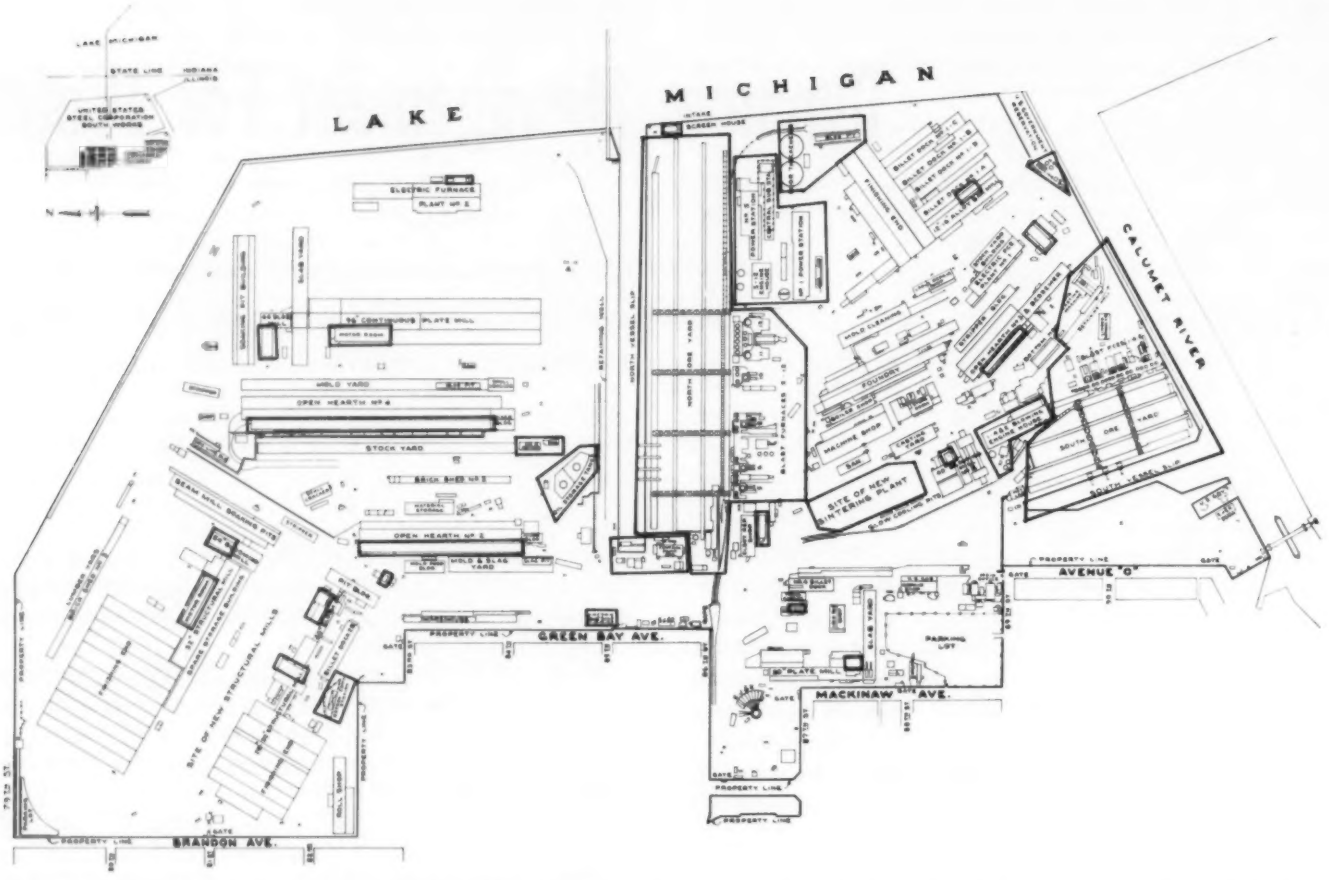


Figure 1 — View shows the plant layout. The blast furnace and power equipment are heavily outlined illustrating the wide spread power division operations.

to measure and control many operations is maintained by the forces of power production.

To give some idea of the necessity for co-operation between units, we would like to point out some fields of study in the blast furnace division where special work by engineers of the power division can be of great value.

1. Air flow and pressure studies.
2. Heat loss studies—to determine the efficiency of stoves, stacks and mains, enabling the furnaces to take corrective action rapidly where trouble spots are noted.
3. Fuel consumption studies—to determine how much and how effectively blast furnace gas is being used by direct purchasers; that is, within the blast furnaces for stove heat, and at rolling mill pits and reheat furnaces and whether, in a particular instance, blast furnace gas, natural gas or alternate fuels are the most economical to use.
4. Fan and blower efficiency studies.

Another area in which co-operation is not only desirable but vital, is in the field of safety. In almost every blast furnace and power operation there is the danger of escaping gas or gas explosions. Co-operation in this field may literally be a matter of life or death. Recognizing the necessity for co-operation is naturally the first step. Success depends on action. Here is the action taken to achieve the desired results:

First the line supervisors had to be educated. We do not mean to imply that our supervisors did not wish to co-operate. However, everyone says its good for you—but learning to like it is something else. Persuading the line supervisor was done through the use of a combination of techniques.

We arranged lectures by power division management to blast furnace supervisors, stressing the power division's dependence on the blast furnaces. Some examples of the themes stressed, were: "We cannot make our budgets if gas deliveries fall due to dirty mains. We will do anything we can to help keep them clean."

Another theme hammered home to the blowers in a dozen different ways was: "If you run the furnaces with bleeders open, we have to replace the gas lost to the atmosphere with outside purchased fuel. This makes us look bad and costs all of us money."

A second technique was the use of letters, individually addressed to blast furnace and power supervisors explaining some of the things we were trying to accomplish.

Two of the letters are shown in Figures 2 and 3. One was concerned with a throw-away sheet published by the power division which was effective in familiarizing all supervisors with the cost of utilities wastage. The other illustrates the sort of information given blast furnace supervisors, so that each one would know what had been done and what would be expected of them.

The supervisor's feeling of being "in the know," because of these letters, helped to make the kind of climate in which co-operation flourishes best.

A third technique of education was that of learning by doing.

It is a truism that man is a creature of habit. Establish the habit of co-operation and it is likely to continue.

We, therefore, arranged for projects of various types to be conducted jointly by a supervisor in power and one in blast furnaces.

Some of these projects were:

1. Find out how blast furnaces get so many methods improvement projects installed and apply their system to power production.
2. Sit in on power division maintenance planning meetings and see if they have ideas that can help us.
3. Work with the blast furnace safety assistant and bring back ideas for speeding up our gas rescue procedure.
4. Work with the power division technical co-ordinator and find out how to calculate gas balances for the plant.

This type of assignment leads not only to understanding the other fellow's problems, but the other fellow. The acquaintanceships formed as the result of these joint efforts stand us in good stead at the working level, when other joint efforts must be made.

Besides the education of the line supervisors, we tried, by the example of higher management, to show that co-operation was not paid lip service on Monday and forgotten on Tuesday.

A continuing effort was made to appear together before the line supervisors and discuss problems of mutual interest. It is always true that what you are speaks louder than what you say. When a foreman or general foreman sees his superintendent willing to "walk the extra mile" with the opposite number in another division, he is more likely to work in harmony with his colleagues in the neighboring units.

In addition to education and example, in certain areas formal working procedures were drawn up by the specific supervisors involved to solve certain specific problems. These were joint efforts, and the procedures were approved by both division heads.

Blast furnace operating and maintenance depts., rolling mills, power, and plant protection were all involved. Each had a definite part to play. It is apparent, that without co-operation of a high order, and mutual respect, this kind of a job would be enormously more complicated.

Concerning this procedure, we should further note that it was written by power and blast furnace supervisors working together from the beginning. In all such work, informal contact and interchange of ideas between the members of the two organizations goes on all the time. What is put on paper is for the formal records.

The formal records are a reflection of what exists in reality, and not as in some instances the picturing of a hoped for, but unrealized situation.

We educated by lectures, letters and practice, we set examples, and we wrote procedures. These things are good in themselves, but we were looking for, and found, something more. What that something more was, can best be shown by example.

Example one—A free exchange of information results in dollar savings. The power division had worked out an excellent inventory control system. The blast furnaces wanted to improve theirs. The blast furnaces sent an engineer to the power division as sort of an "exchange student." He brought back, among other things, a system of inventory control, which applied to blast

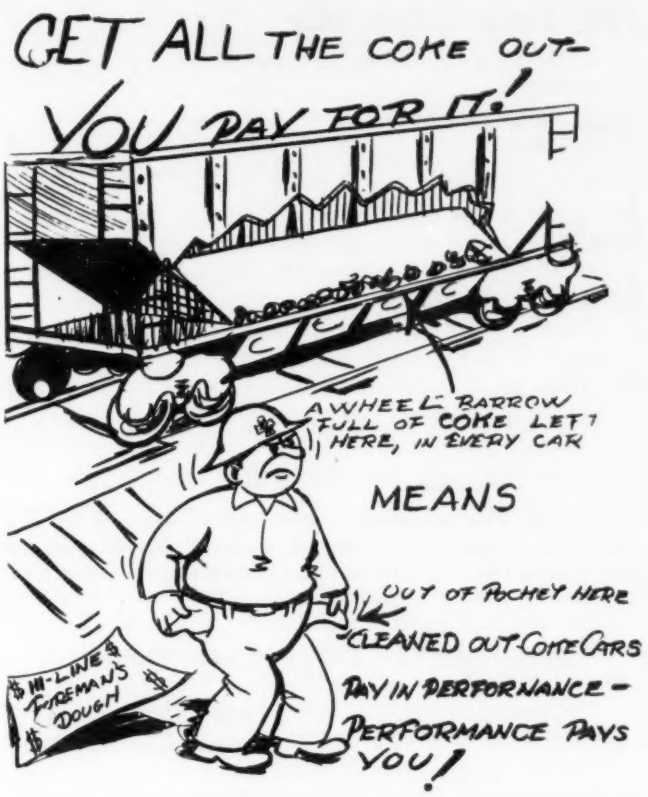

GET ALL THE COKE OUT—
YOU PAY FOR IT!
A WHEEL BARROW FULL OF COKE LEFT HERE, IN EVERY CAR
MEANS
OUT OF POCKET HERE
CLEANED OUT COKE CARS
PAY IN PERFORMANCE—
PERFORMANCE PAYS YOU!
HI-LINE FOREMAN'S DOUGH

Figure 2 — Letter sent to foremen to stimulate cost reduction indicates the type of direct appeal used.

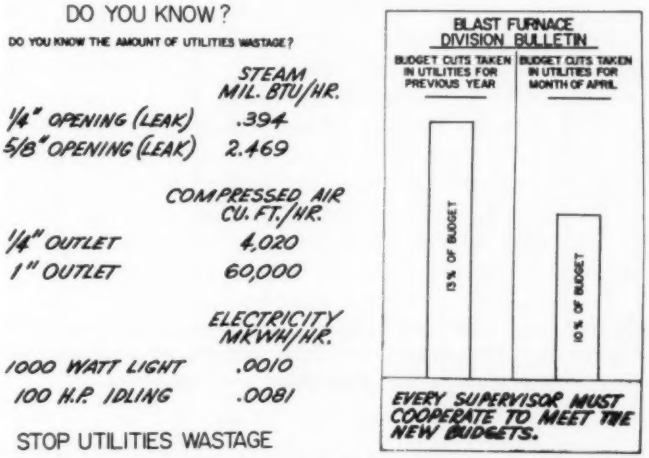
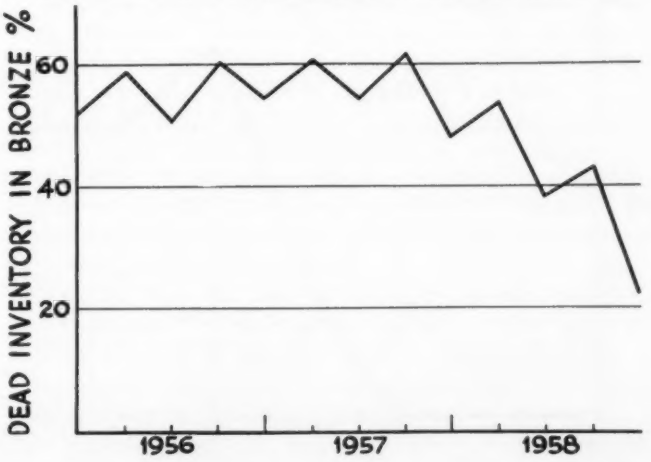

DO YOU KNOW?
DO YOU KNOW THE AMOUNT OF UTILITIES WASTAGE?
STEAM MIL. BTU/HR.
1/4" OPENING (LEAK) .394
5/8" OPENING (LEAK) 2.469
COMPRESSED AIR CU. FT./HR.
1/4" OUTLET 4,020
1" OUTLET 60,000
ELECTRICITY MKWH/HR.
1000 WATT LIGHT .0010
100 H.P. IDLING .0081
STOP UTILITIES WASTAGE
BLAST FURNACE DIVISION BULLETIN
BUDGET CUTS TAKEN IN UTILITIES FOR PREVIOUS YEAR
BUDGET CUTS TAKEN IN UTILITIES FOR MONTH OF APRIL
13% OF BUDGET
10% OF BUDGET
EVERY SUPERVISOR MUST COOPERATE TO MEET THE NEW BUDGETS.

Figure 3 — Information sheet distributed to supervisors broadens perspective relative to waste costs.

Figure 4 — Graph of bronze inventory indicates reduction of total stocks as a by-product of information exchange.



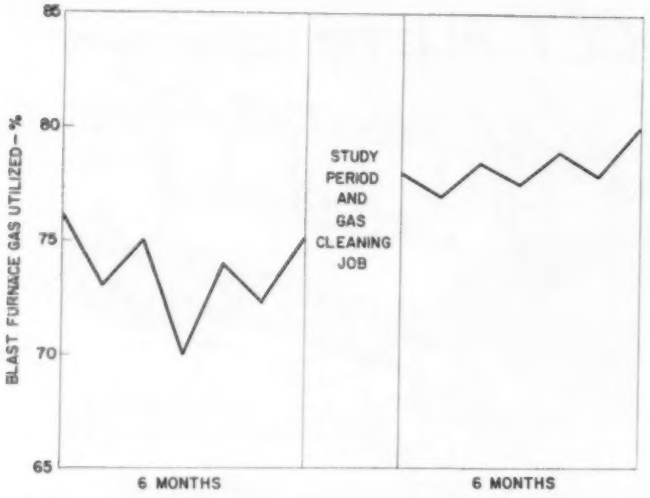


Figure 5 — The tabulated information obtained from a cooperative operation, detected a partly clogged gas line and resulted in ultimate savings after cleaning of the line.

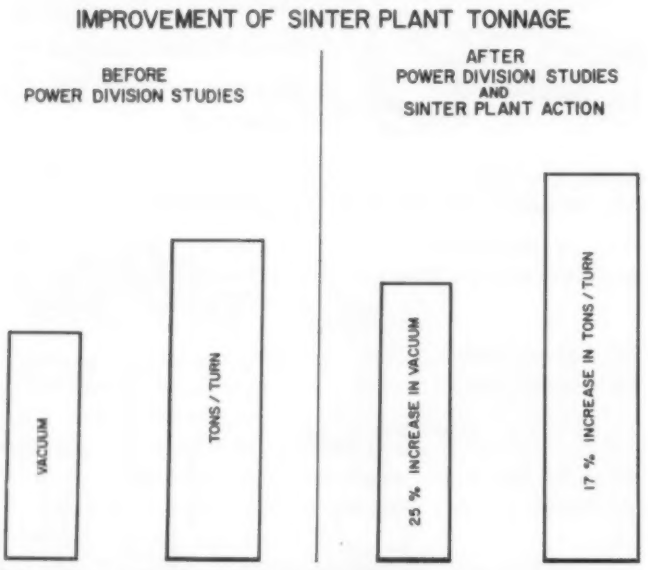
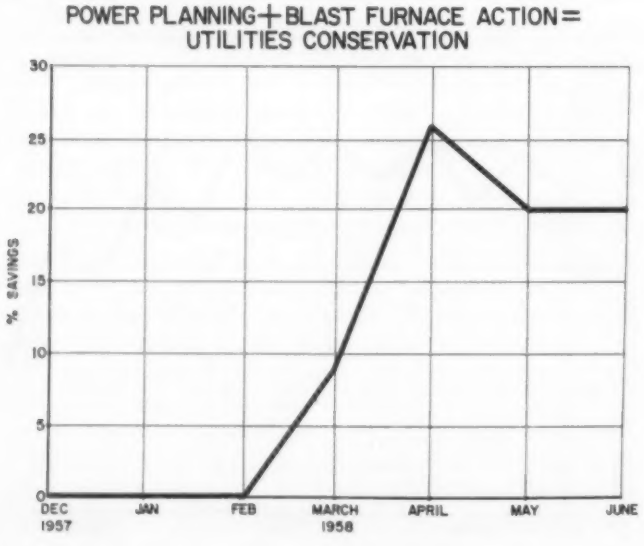

IMPROVEMENT OF SINTER PLANT TONNAGE
BEFORE POWER DIVISION STUDIES
AFTER POWER DIVISION STUDIES AND SINTER PLANT ACTION
VACUUM
TONS / TURN
25 % INCREASE IN VACUUM
17 % INCREASE IN TONS / TURN

Figure 6 — The graph tells the results of another co-operative project which decreased over-all costs.

Figure 7 — Reduction of utilities usage has represented a substantial operating cost reduction.



furnace bronze stocks, such as: tuyeres, blowpipes, etc.

Reducing dead bronze inventories from 50 per cent of the total inventory to about 20 per cent is certainly a tangible result, as shown in Figure 4.

Example two—The blast furnaces had evolved a communications method which had good results in developing an alert, informed and forward looking supervisory group.

The method was a simple one of supplying bulletins to each supervisor concerning cost problems, operating problems and safety or spreading good news.

Division management is concerned with problems such as coke wastage, production performance, steam wastage, methods improvement and good housekeeping. What is most important is not that division management is concerned, but that in each of these problem areas, when the line supervisors were given the facts they took effective action to correct deficiencies and improve operations.

Because of the free exchange of ideas between divisions, the same technique was picked up and used by the power production division. However, because the operations of the power division permitted the holding of meetings at which supervisors could be met personally, the method of communication was through conferences rather than bulletins.

These simple things are often underestimated.

We had a problem in operations. Our use of coke was too high for the kind of operation at the time.

We called the attention of our supervisors to the problem with a distribution of "throw away" bulletins, and the results were highly gratifying with operations showing a decrease in coke and increase in yield.

Example three—This is a case history of co-operative effort to achieve a desired result. It was to the advantage of the blast furnaces to sell as high a percentage of the gas produced as possible.

It was in the interest of the works to use as much blast furnace gas as possible to replace outside purchased fuels. The problem to be solved, was: "How do the furnaces go about delivering more gas?"

The first step was to determine what kept gas deliveries down to 70 to 80 per cent of that produced.

The power division undertook studies of gas pressures in the various mains. The findings of the power people were that a particular section of the main was a bottle neck due to a build-up of dirt which restricted gas flow to the power station, and that cleaning this section would improve deliveries significantly.

This section was then cleaned by the blast furnaces at considerable cost. Figure 5 shows the increased gas utilization before and after the work.

The cost of cleaning the main was recovered in less than a month. The significant point here is the complete reliance of blast furnace management on the reports and recommendations of the power division. Without such mutual respect, this type of action could not have been taken.

Other examples of co-operative effort are:

1. A power division study of windbox vacuums and fan efficiency at our No. 1 flue dust sintering plant resulted in action to increase vacuum and thereby increase production. Figure 6 tells the story. As the result of the studies and work, the vacuum was increased

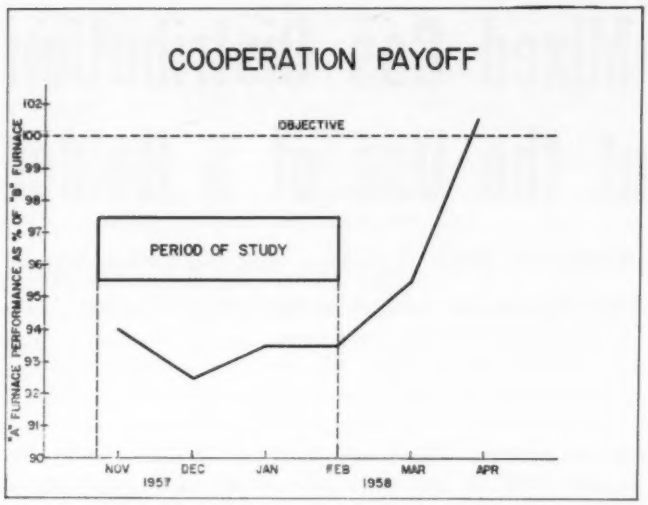


Figure 8 — A comparison of furnace performance may help outline areas for savings.

25 per cent and tonnage produced per turn was increased over 17 per cent.

2. A reduction in the use of utilities by the blast furnace division, based on conferences with power division supervisors and a utilities conservation check list developed by the power division. Pictured in Figure 7 is a month-by-month graph of the savings in electricity in the production of hot metal. A 20 per cent savings in utilities usage resulted.

3. A comparison of operating performance between two identical blast furnaces was made by the blast furnaces with the help of the power division. This was a case where the cumulative trust of several years paid good dividends. The problem was: why should two furnaces, identical in almost every respect, have differing coke rates and production rates?

Some of the items jointly investigated and evaluated by blast furnaces and power were:

1. Check out of all instrumentation to make sure recorded information was valid.
2. Analysis of stove heat losses.
3. Analysis of excess furnace winds.
4. Analysis of furnace top gases.

For this project, each unit made the initial assumption that the problem must be within its own framework. This made for the kind of situation in which the maximum light can be shed on the problem while generating a minimum amount of heat. The result of the work done is shown graphically on Figure 8.

While the problem has not been completely solved great progress has been made, and performances have begun to approach each other on the two furnaces.

The examples cited do not exhaust the list by any means. They are not necessarily the best examples, but were chosen for their variety and possible application to the use of other plants. Even the specific things done may not apply to any particular operation, but the principle involved is important and can be applied anywhere.

The principle is simple. The first cost in any steel plant is for hot metal production and power production. Co-operation between them for added strength to each means a better product at a lower cost. Co-operation is what generates *dynamic management for profit!*

Discussion

PRESENTED BY

W. FLANAGAN, Retired, Pittsburgh, Pa.

W. Flanagan: In addition to the obsolete equipment we have to get rid of, we have to get rid of some of the obsolete or defeatist practices in our plants.

In talking about blast furnace cleaning, the big advantage in clean blast furnace gas is the saving in investment. If we build boilerhouses on the defeatist attitude, that we are never going to have clean gas, we are never going to have gas pressure. We build the furnaces for a minimum of 50 in. of water pressure at the blast furnace top, which we throw away with poor gas cleaning and inadequate gas lines and get five in. at the burners.

Now, with 50 or even 25 in. available at the burners, you can burn 75-Btu gas. If the gas is clean at the high pressure burners, you do not need the tremendous combustion chambers and larger buildings on which we have been forced to spend company money in the past.

There are other factors. A modern completely integrated steel works could practically run everything on its own by-product fuels, which were previously considered waste fuels. The idea of waste fuel makes one disgusted. Remember, the European, the South American and the Russian steel plants are built to save fuel and are run in the most economical manner. They have not yet learned to utilize their labor properly, but they have learned to utilize the fuels, the power and the investment to the best possible extent.

It is up to us to eliminate the loss of pressure between the blast furnaces and the blast furnace gas consuming points. That is an economic waste because we burn up a lot of power to make that gas pressure, and we should either reduce blowing power or we should utilize the gas pressure that is available, not throw it all away so that a reduction of calorific value prevents combustion.

The same thing is applicable in a new powerhouse. Whether it be a gas turbine or a gas-fired boiler, if we are going to have the most economic installation investment we must have clean gas in advance. We must have the gas pressure available in advance. The co-operation that has been mentioned by Mr. McDonough and Mr. Krapf in their paper illustrates the possibility of not merely maintaining pressures but also maintaining the delivery.

When I started in the business many, many years ago, the blast furnaces did not pay too much attention to the fact that they were producing a valuable fuel and that it was only valuable to the power department when it came with reasonable continuity. So they would not check stoves at periods of lowered gas production. They fired stoves at any rate they wished to, regardless of the availability for the power system. A little while later the bleeders would be opened as the stoves would be too hot to use full gas input.

The keynote of the Krapf-McDonough paper is co-operation. Fullest co-operation is essential from all parties not only to meet foreign competition but also to avoid losing the foreign trade which has always been required to provide full operation of the steelworks in the United States. ▲

Safe Control of a Mixed Gas Distribution System Without the Use of a Holder

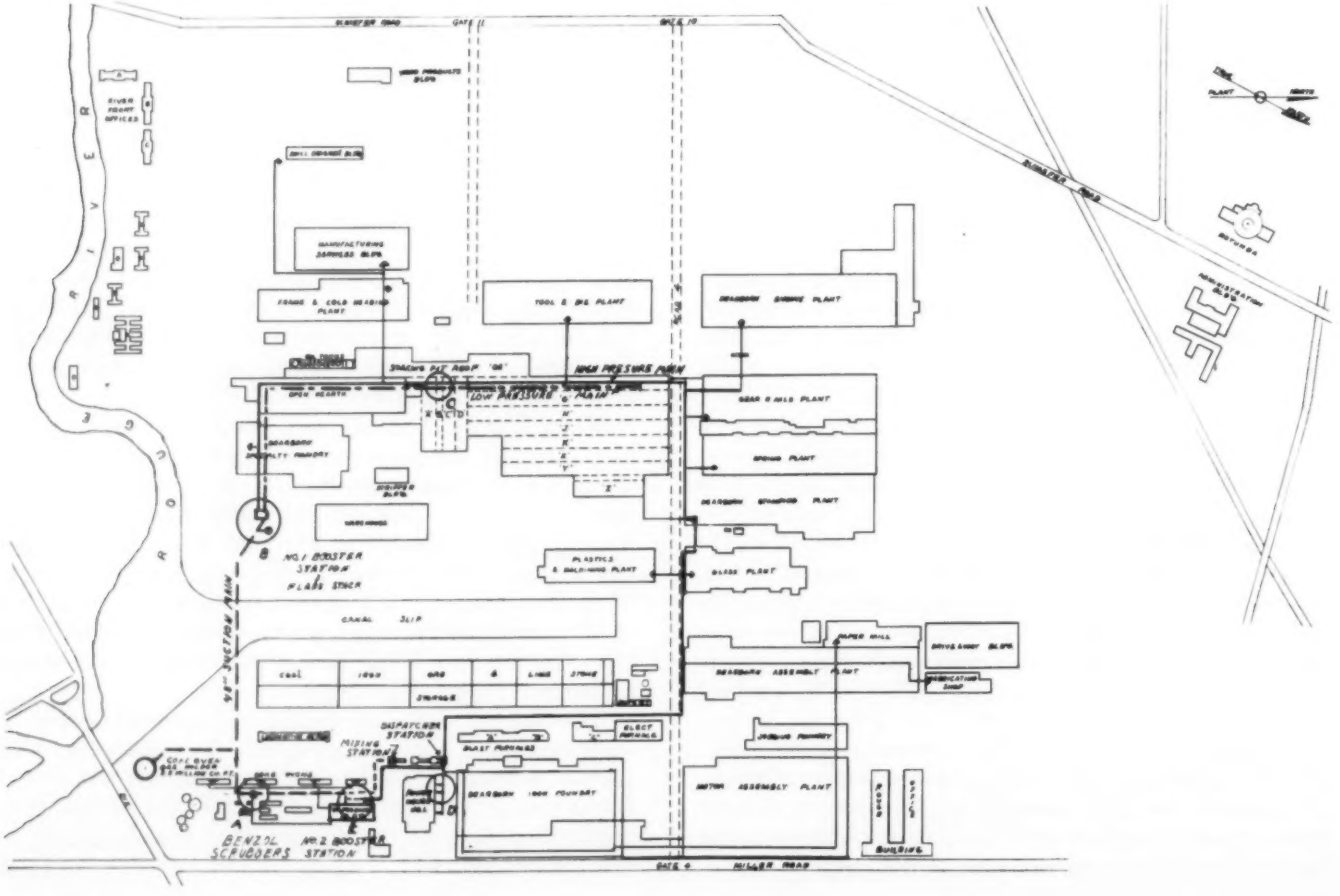
by BURTON D. BARNS, Supervisor, Fuel and Utilities Section,
Plant and Production Engineering, Steel Division, Ford Motor Co., Dearborn, Mich.

. . . . by making a few modifications, Ford's Rouge plant's mixed gas system was operated for 36 days without a storage holder . . . . in this period there was no production loss because of insufficient gas at normal operating pressure . . . .

IN the spring of 1957, it became apparent that the Rouge plant's 2,500,000-cu ft mixed gas holder must be removed from service for repair. The loss of the holder would pose a major problem in gas distribution throughout the plant. There was no other means of storing gas to satisfy the hourly fluctuating demands on the system. The method of control had to be designed to meet our own particular safety and transmission requirements which were applicable only to our distribution system. The problem can best be understood when one is familar with the mixed gas system at the Rouge plant.

Four batteries of coke ovens located in the southeast corner of the Rouge plant and consisting of 220 ovens produce about 3600 tons of coke per day. The resultant coke gas is evacuated from the ovens by two of three centrifugal exhausters located in what is known as No. 2 booster station. These exhausters have a capacity of 22,600 cfm each. They remove the gas from the ovens and raise its pressure to 80 in. of water. The resultant pressure is used to pump the gas through the by-products plant where tar, ammonia, naphthalene and light oil are removed. The gas leaves the benzol

Figure 1 — The dotted lines illustrate the suction main leading to the two booster stations. No. 1 station is across the boat slip and No. 2 station is located between the benzol scrubbers and the powerhouse to the north.



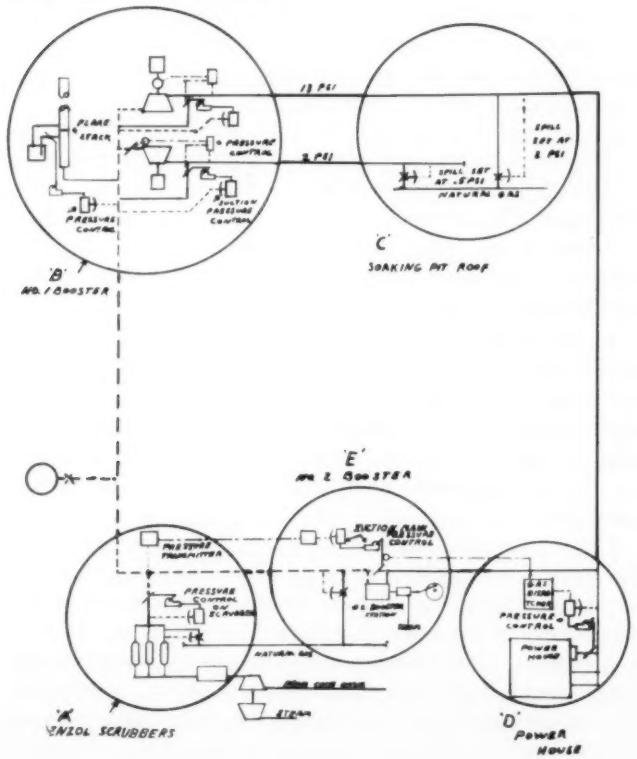
scrubbers as debenzolized coke gas.

The debenzolized coke gas is mixed with blast furnace gas at the discharge of the scrubbers to produce approximately 2,000,000 cu ft of 500-Btu mixed gas per hour. This mixture is burned in both steel and automotive operations in the Rouge plant. The mixture leaves the scrubber area through a 60-in. main which proceeds directly west and becomes the suction main for two booster stations. These stations feed 13-psi gas from opposite ends of the plant loop.

No. 2 booster station consists of six positive displacement boosters having a total pumping capacity of approximately 1,900,000 cfhr, and discharges to the plant loop main at 13 lb psi. These boosters receive their gas through a 30-in. main tied to the 60-in. main just west of the mixing point. No. 1 booster station connects to the end of the underground 60-in. main at a point west of the boat slip and approximately ½ mile west of the benzol scrubbers. The station houses five gas boosters. Two centrifugal boosters, having a capacity of 600,000 cfhr each, raise the gas pressure to approximately 13 psi, and feed the opposite side of the plant main loop. The other three centrifugal boosters have a capacity of 600,000 cfhr each and produce 2-psi gas, which is used solely in steel operations. On the 60-in. main between the coke ovens and the boat slip is a tee connecting the holder to the system. The holder is located south of the gas main.

The high pressure gas main travels directly west from No. 1 booster station over the roof of the steel foundry to the open hearth roof. From this point, the main travels north over the steel mill roof to road No. 4; the main road which divides the plant. Here the line again turns east and proceeds to the blast furnace high line where it turns south and eventually connects to the discharge line at No. 2 booster station. Taps are taken off this loop, not only for the steel mill,

Figure 2 — Schematic shows system of controls to operate Rouge plant without holder.



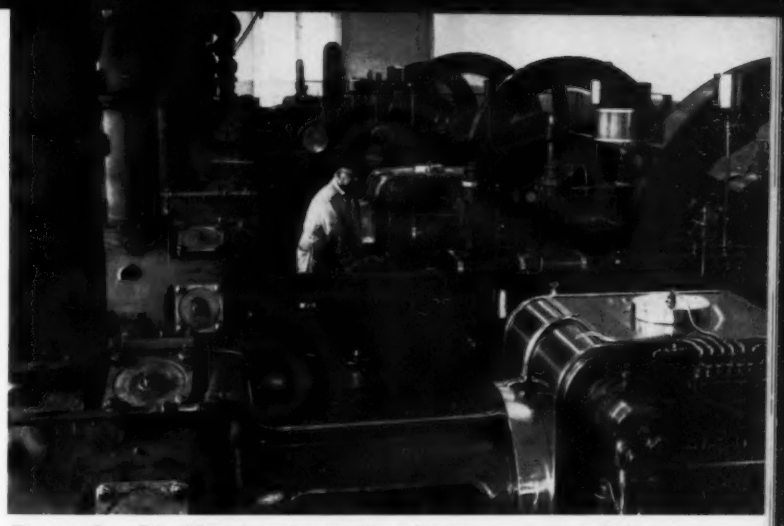


Figure 3 — Six 12-psi reciprocating boosters are used in No. 2 booster station.

but also for the numerous automotive operations adjacent to the line, and the powerhouse just north of No. 2 booster station.

A mixing station, located between the power house and No. 2 booster station, connects to the 30-in. suction main feeding No. 2 booster station. This mixing station is capable of supplying to the system 500,000 cfhr of mixed, blast furnace, natural gas blended to 500 Btu per cu ft. Usage of the station capacity is limited primarily due to its physical location on the system. Too much gas from this station, in proportion to the amount of coke mix handled by No. 2 booster station, affects the burning characteristics of the final mixture. The foundry, the first gas consumer on the discharge of No. 2 booster station, is seriously affected. Their combustion equipment does not allow for wide variations in gas gravity.

The automotive manufacturing combustion equipment consists primarily of high pressure burners which would have required changes in spuds, orifices or pilots to burn a substitute fuel. To revamp the numerous burners at the widely dispersed locations would have been prohibitive in cost as well as in possible loss of production. Therefore, it was apparent that these operations must be furnished sufficient mixed coke-oven gas, safely, without an interruption.

The question of furnishing sufficient mixed coke-oven gas safely to the Rouge plant had to be based on four major concepts.

1. There would be no storage facilities to alleviate the sudden fluctuations in the system.
2. An increase in gas supply over the demand could back pressure to the ovens, making it necessary to "beehive" the ovens.
3. An increase in demand over the supply of gas could result in air being pulled into the system.
4. A sensing point must be chosen to determine the relation of supply and demand.

The first concept was obvious, since the only holder available was to be removed from service and valved off at the 60-in. suction main. The second concept could only be met by dissipating the excess gas. This could be done by either flaring the gas or using it as some point such as the powerhouse, where the demand could be great enough and instantaneous facilities for substituting fuels was feasible. In our system, provisions were made to do either, although flaring was a last resort.

Figure 4 — Three 2-psi and two 12-psi boosters are used in No. 1 booster station.

Figure 5 — Controller regulates the bleed valve to the powerhouse and is located in the powerhouse. This is a dual pump unit. It was hooked up electrically such that should one pump fail the other pump would automatically start.

Figure 6 — Located on the desk in front of the operator is the pushbutton which sets the pressure controller in the powerhouse.

The question of the demand becoming greater than the supply haunted operations during the entire period the holder was down. As mentioned previously, we had limitations to our mixing station, and there was always the possibility of pulling a negative pressure in our loop system. The mixing station had to be operated as sparingly as possible. When it was operated, the portions of gas from the mixing station and mixed gas pulled through No. 2 booster station had to be carefully watched. Spill stations at four different locations on the loop were provided to bleed natural gas into the line to maintain a pressure should a serious drop in pressure result in these areas.

The last concept involved the very heart of the operation. It was realized from the beginning that some means of sensing what the holder would be doing, were it in operation, was necessary. After a study of pressures on the system, it was determined that a pressure point at the start of the 60-in. suction main should sense the relation of supply to demand.

Before proceeding with an explanation of the system operation, it would be well to point out that all gases on the system are handled through a dispatching station. This station is located adjacent to the powerhouse and is housed in a building designated the "KK" building. Pressures and flows from the various locations on the system are recorded at the dispatcher's board.

The powerhouse shown at the bottom right hand corner of Figure 2 was delegated the responsibility of relieving the main pressure when the supply exceeded the demand. This was accomplished by a hydraulic pressure controller which received its impulse from a point upstream of the control valve. The control pressure could be varied by a pushbutton on the dispatcher's desk. Pressure within the powerhouse mains was maintained at approximately two psi by c ntr lling the burner valves at the boilers.

To the left of the powerhouse is illustrated the controls at No. 2 booster station which houses the six positive displacement boosters. These controls were the heart of the control system since they governed the pressure at the sensing point. The pressure was controlled by either recirculating gas to the suction main or causing gas to be bled at the powerhouse. A drop in pressure at the sensing point caused gas to be recirculated. A rise in pressure at the sensing point decreased the recirculation and consequently the loop pressure rose. The loop pressure increase above a preset value was relieved by the action of the powerhouse pressure regulator.

A hydraulically-operated butterfly valve installed in the by-pass between the station discharge line and the suction main governed the recirculation. The action of the valve had a two-fold value. It protected the suction main from reaching a vacuum state and also served as a demand indication to the booster station operator.

Connected to the butterfly shaft was a switching device which lit green, amber and red lights in sequence as the valve opened. These lights were located at the station control board and furnished the operator with a means of determining the amount of recirculation which was taking place. The operator attempted to keep the recirculation to a minimum by removing boosters from service or slowing down those in service.

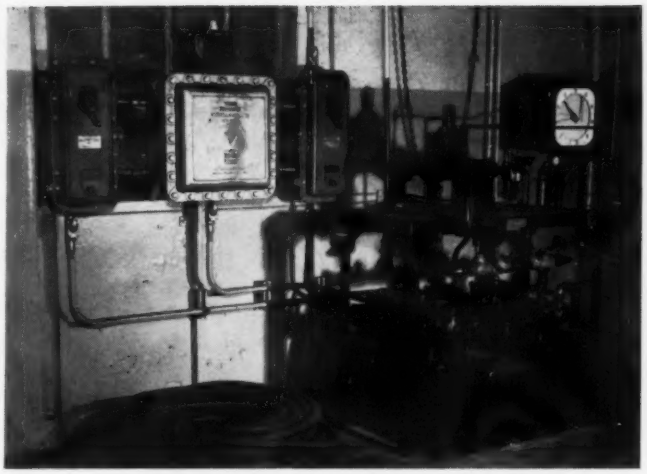


Figure 7 — Regulator operates the butterfly valve between the No. 2 booster station discharge and suction line. In the corner is the potentiometer which intercepts pressure signal from the benzol scrubber area and transposes that signal into a pneumatic signal which in turn positions the controller.

The by-pass butterfly valve was actuated by a hydraulic regulator which governed the pressure in the suction main to maintain a positive pressure. The regulator was mounted inside the booster station. The sensing point was at the benzol scrubbers, 500 ft away. Impulse lag was avoided by electrically transmitting from the sensing point to a recording, controlling, potentiometer adjacent to the pressure regulator. A pneumatic impulse, retransmitted from the potentiometer to the pressure regulator, governed the operation of the regulator.

As a further precaution against pulling a vacuum in the suction main, a self-contained pressure regulator was connected between a natural gas line and the suction main. This regulator was set to spill natural gas into the suction main should the main pressure reach one in.

The area shown in the lower left-hand corner of Figure 2 indicates the location of the benzol scrubbers and the point where raw coke gas is diluted with blast furnace gas. Also, the sensing point is shown from which the by-pass controller at No. 2 booster station was operated. The pressure at this point was controlled at approximately eight in. of water.

The control system involved at No. 1 booster station is illustrated in the upper left-hand corner of Figure 2. Here again, we felt it necessary to protect against pulling a vacuum on the suction main. Both the high and low pressure boosters were equipped to allow gas to flow from the booster discharge to the suction main with by-pass lines. The butterfly valves on these lines were controlled by hydraulic pressure regulators. Should the pressure in the suction main reach a preset value, these regulators would automatically open the valve and attempt to maintain a positive pressure in the suction main. The low pressure by-pass was set to open first, and the high pressure to follow, should the need arise.

The regulators were mounted above a dual tank having two pumps. The pumps were wired electrically so that should one pump fail, the other pump would automatically start to maintain hydraulic control pressure. This same system was used on the powerhouse hydraulic pressure regulator.

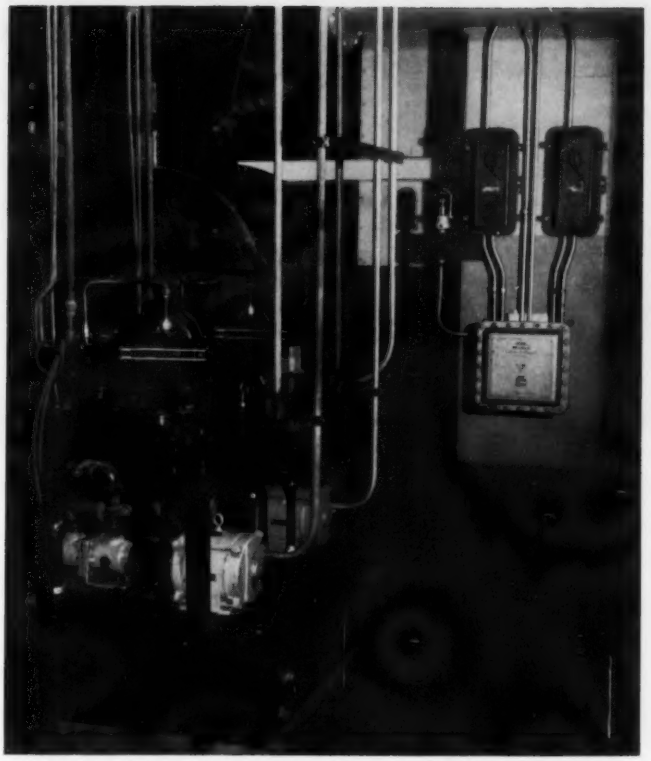


Figure 8 — Two pressure regulators were located in No. 1 booster station. One regulator operated the by-pass butterfly valve for the low pressure boosters. The other handled the high pressure booster by-pass valve.

The low pressure boosters' discharge pressure is normally controlled by an electrically driven butterfly valve at the booster inlet. These valves had to be interlocked with a limit switch on the by-pass valve. The instant that the by-pass valve opened, the electrically driven butterfly valve was locked into position until

Figure 9 — No. 1 booster station is shown with flare stack in front. The building in the foreground houses the controller used to open the bleeder when the suction main pressure rose too high.

Figure 10 — On the roof of the rolling mill two self-contained regulators were installed to protect against a vacuum occurring at this point in the loop.

the by-pass valve again closed.

The pressure derived by the high pressure boosters is normally controlled by the hydraulic coupling connected to the blower. The pump feeding the hydraulic coupling was disconnected electrically by the action of a limit switch mounted on the by-pass butterfly valve. When the butterfly valve opened, the speed of the blower remained constant until the suction main pressure was restored and the by-pass butterfly closed.

Just outside No. 1 booster station, and connected to the suction main, was erected a flare bleeder. The stack was approximately 125 ft high. A water seal tank was connected between the main and the stack to prevent air from infiltrating into the main. A hydraulic pressure controller was installed between the water seal box and the stack. This controller was set to open and control when the suction main pressure exceeded 10 in. of water.

On top of the rolling mill roof, two self-contained regulators were installed to protect against a vacuum occurring at this point in the loop. One regulator was set to spill natural gas into the 2-psi line when the pressure in that main reached 0.5 psi. The other regulator was set to spill natural gas into the high pressure loop when the main pressure reached one psi.

The Rouge plant mixed gas system was operated for 36 days without a storage holder. During the entire period, there was no loss of production due to an insufficient supply of gas at normal operating pressure.

Discussion

PRESENTED BY

PETER B. MACKENZIE, Combustion Engineer, Atlas Steels, Limited, Welland, Ontario, Canada

BURTON D. BARNS, Supervisor, Fuel and Utilities Section, Plant and Production Engineering, Steel Div., Ford Motor Co., Dearborn, Mich.

L. I. DICKINSON, Fuel Engineer, Bethlehem Steel Co., Lackawanna, N. Y.

DAVID COUSLEY, Assistant Superintendent, Utilities, Wheeling Steel Corp., Steubenville, Ohio

Peter B. Mackenzie: During the time the holder was out of service, a rise in gas pressure was primarily counteracted by increasing powerhouse fuel consumption. What equipment was used to effect the necessary rapid fuel substitutions and how effective was it?

Burton D. Barns: The boilers normally use powdered fuel. Equipment is provided in the powerhouse to measure the pressure in the main downstream of the control valve. As this pressure fluctuates, the measured impulse pressure actuates a controller varying louvres at the boiler burners. As the gas flow varies, the coal feeder speeds also to increase or decrease the coal fed to the boiler to maintain the predetermined heat input. The system worked very satisfactorily.

Peter B. Mackenzie: Likewise, when high demand lowered loop pressure, did any problems arise from local enrichment by natural gas bleeder action?

Burton D. Barns: The local natural gas bleed stations were installed as a precaution against the possibility of reaching a vacuum state in the mains. The pressure in the lines never reached a state sufficiently low enough to cause the bleed valves to open.

L. I. Dickinson: In the application of 500-Btu mixed blast furnace and natural gas, which would have a specific gravity somewhere in the range of 0.75, would it be possible to use a different mixture of these two gases so that the gravity correction could be compensated for and the combustion controls could measure this gas as a synthetic mixture of blast furnace and coke oven gas at 500 Btu?

Burton D. Barns: Our problem evolves about the fact that our automotive users burn the gas primarily through inspirating burners. The mixture of which you speak could be used by resizing the burner jets. The possibility of having to change from a mixed coke oven-blast furnace gas mixture to a natural-blast furnace gas mixture, and then back to the original mixture on short notice would cause loss of production while the burner jets were being changed.

L. I. Dickinson: The second question concerns the possible load variation as to magnitude. How does the sum total of the variations compare to the total blast furnace-natural gas addition to balance the system? Also, can any of the consuming units be changed over to other fuels should it be necessary?

Burton D. Barns: I have no figures concerning the gas variations and the blast furnace-natural gas additions. I will say this that we kept the amount of natural gas usage to a minimum. Our hot mill furnaces, soaking pits and bar mill furnaces are capable of using natural gas.

L. I. Dickinson: How much, if any, of the blast furnace-coke oven gas was bled and how does this compare with normal operation?

Burton D. Barns: Normally we do not flare any mixed gas. Although we were unable to measure the flared gas, the quantity flared was very small compared to the total gas handled.

David Cousley: You had two pumps on your hydraulic control system, one to act as a spare, but both electrically driven. What would have happened in case of power failure with both pumps being kicked off?

Burton D. Barns: Each of these pumps was connected to a different circuit to minimize the possibility of loss due to power failure. Other types of prime movers could have been used, but it was felt that an extreme power failure would cripple our operation to the extent that the loss of the pump motors would be unimportant. ▲

Modern Trends—Sintering Plants And Blast Furnaces

by D. P. CROMWELL, Associate, William M. Bailey Co.
and Associate Professor, University of Pittsburgh, Pittsburgh, Pa.

THE paper is divided into three portions. First, past history is used as a base that cannot be disputed. Second, present-day operations are evaluated to locate its position on the upward curve of progress. The third phase, or future cannot be exactly located but the time phases are the only variables in the picture.

Quoting from I. Lowthian Bell's book, published in 1872, entitled "Chemical Phenomena of Iron Smelting":

"The first blast furnace erected with special reference to smelting the ironstone, now known as the Cleveland, was built under my own superintendence, in 1846, at the Walker Works, on the Tyne. The stone itself was brought from the neighborhood of Whitby, and the furnace has a capacity of about 3500 cu ft.

"A year or two afterwards, Messrs. Bolokow and Vaughan commenced to smelt the same ore in furnaces having a capacity of only 2850 cu ft, which they had built at Witton Park, in the hope of obtaining supplies of material from the immediate neighborhood.

"I mention these circumstances to show that at the periods in question, whatever had been done in the erection of larger furnaces elsewhere, the results had not been such as to induce my late friend, Mr. John Vaughan, or myself to venture on departing from dimensions of a very moderate character; indeed, in the course of our constant communication on the subject, I made known to him the fact, that at the Wylam furnace, containing only 2350 cu ft, we were doing work as efficiently as in that at Walker, nearly one half larger.

. . . . predicting future progress from the past is intriguing . . . . past developments in blast furnaces indicate even more startling trends in the future . . . .

"In the year 1850, ironstone, obtained from the Eston mines, was sent to Witton Park, and, in consequence of the favorable yield, three furnaces were erected in 1851 at Middlesborough to smelt it. They were only 42 ft high, with a capacity of 4566 cu ft. These were followed the next year by two others, 45½ ft high, of 5100 cu ft capacity, the property of Messrs. Gilkes, Wilson, Pease and Co.

"There was nothing in the consumption of fuel at any of these furnaces to indicate the existence of any advantage over the Wylam furnace of little more than half the size, for on referring to my early notebooks, 35 to 37 cwt of coke were often consumed to produce a ton of grey iron, and I have known it as high as two tons.

"In the month of January, 1854, my partners and myself blew in, at the Clarence Works, what were at the time the three largest furnaces in the district, viz, 47½ ft high, having a capacity of 6174 cu ft. Up to that period little had been done in applying the escaping gases as a means of heating the blast, Mr. Vaughan having discontinued its use from the trouble involved in cleaning the stove pipes.

"Impressed with the importance of having the air highly heated, and independently of any attention on the part of the workmen, we made the use of the gases to the air stoves at the Clarence Works the first object of study, and from the high temperature obtained and its regularity, we speedily reduced the coke consumption considerably below 30 cwt to the ton of iron.

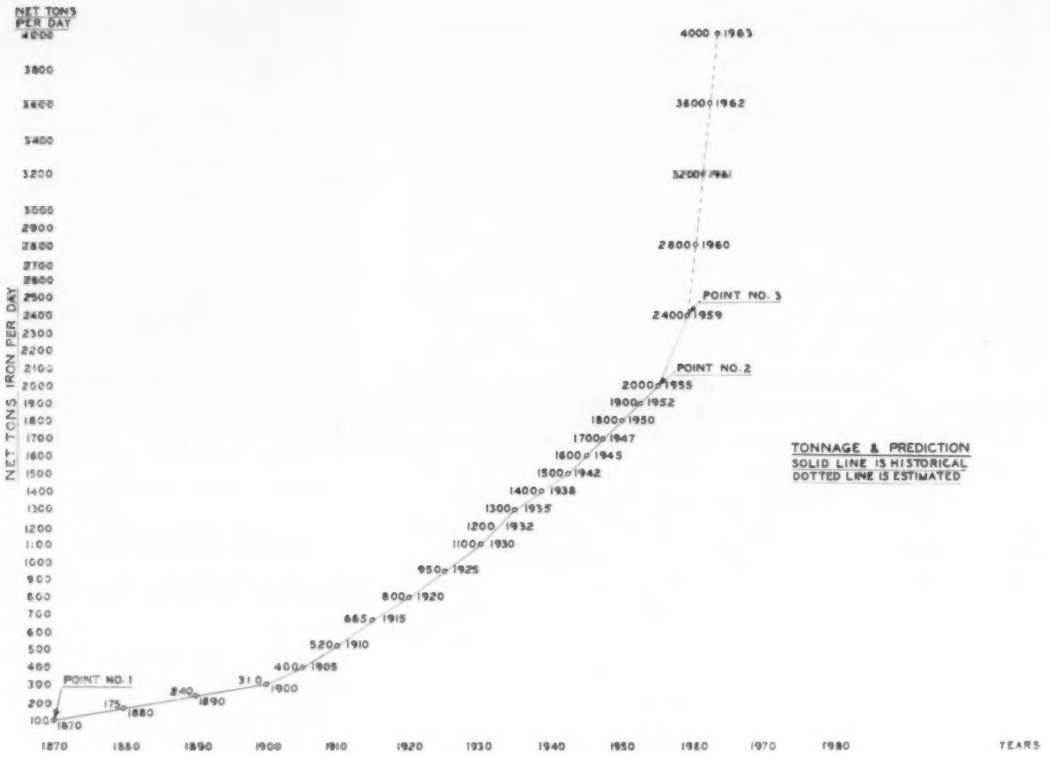


Figure 1 — Chart predicts future production capabilities of blast furnaces. Solid line is actual historical data, dotted line shows predictions.

"The following list contains the other furnaces erected on the banks of the Tees up to the end of 1858:

		No. of furnaces	Ft high	Cu ft
1853	Eston	6	54	7116
1854	Ormesby	4	55	7175
1854	South Bank	3	50	5050
1854	Cleveland	3	54	7116
1854	Tees-side	2	55	6800
1856	Stockton	3	50	6341
1856	Norton	3	50	6000
1858	Claylane	3	56	7000
1858	Tees-side	2	56½	7200
1858	Normanby	3	58	8000
1858	Witton	1	61	7950
1858	Tees	2	55	7700

"Having constant opportunities of ascertaining the duty performed by nearly the whole of the above named furnaces, in many cases from actual copies of the consumption sheets, I was so satisfied that no perceptible advantage had been derived from an increase of dimensions gained entirely by an addition to the height, that other three furnaces were erected at Clarence, subsequent to 1858, of the same size as those already mentioned, making the entire number six.

"In the year 1861, Messrs. Whitwell erected three furnaces at Thornaby, 60 ft high, but having boshes of 20 ft, their cubic capacity was 12,778 ft. Occasionally, I heard of very favorable results being obtained at this establishment, but nothing beyond those sometimes attending the use of the furnaces at the Clarence Works, which, in the year 1860, occasionally worked at 25 cwt, and, not unfrequently, at 26 to 27 cwt for grey iron. It may be remarked that it is quite possible that, in the comparison which I have attempted, in this somewhat rough manner, to draw between furnaces up to a capacity of 6000 cu ft, due regard was, perhaps, in the absence of all authentic information, not paid to the more or less efficient way in which the blast they received was heated. Had this invariably been done, I dare say, differences in favor of the larger furnaces would have been perceived. That this is highly probable would appear from the fact, communicated to me by my friend, Mr. William Whitwell, from which it would appear that when the blast was maintained at the Thornaby Works at 900 F the consumption of coke over a whole year averaged about 25 cwt to the ton of iron.

"Such was the condition of things when the means of raising the temperature of the blast beyond anything conceived as possible, was proposed by Mr. E. N. Cowper, in his firebrick stove, and its power in this respect was tried at the Clarence Works in 1861, and somewhat earlier than this by Messr. Cochrane, at Ormesby, in both cases on the furnaces already spoken of.

"The next important step in the history of ameliorating the process of smelting iron was the erection, late in 1862, at Middlesbrough, of a furnace designed by Mr. Vaughan. It was of smaller cubic capacity than that of Messr. Whitwell, viz., 11,985 cu ft instead of 12,778, but it was 75 ft high, instead of 61.

"Mr. Vaughan having reported to me an improvement in its performance compared with the old furnaces, I proceeded, by his permission to endeavour to ascertain the causes of the difference, and to a certain extent these were communicated in a report to the British Association for the Advancement of Science in the following year.

"I was so satisfied of the superiority of this change in

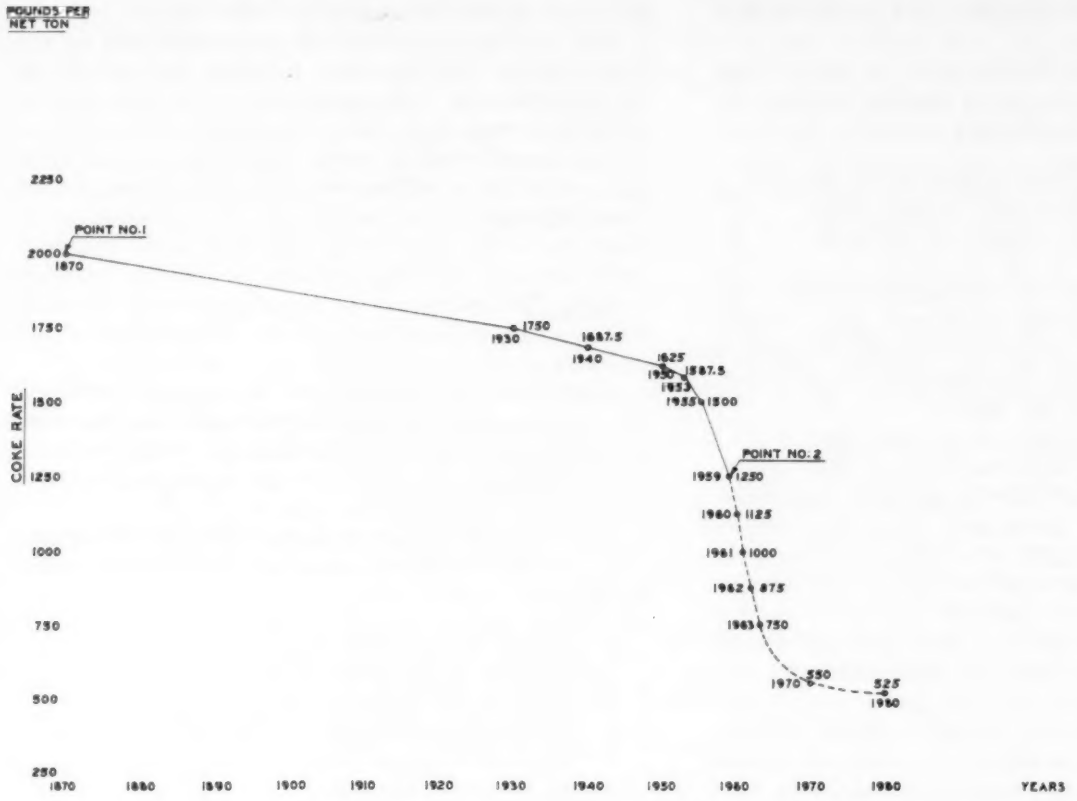


Figure 2 — Chart predicts future coke rates for blast furnaces. Solid line is actual data, dotted line shows predictions.

the form that I had plans prepared immediately for a pair of furnaces, 80 ft high, with a capacity of 15,500 cu ft; and other firms acting in like manner, within eighteen months several new establishments were set to work, varying from 67 to 81 ft in height, and containing from 12,000 to 17,700 cu ft.

"The iron manufacturers of the district by this time had in these enlarged furnaces, blown with air, capable of melting zinc in four to six seconds, probably 850 to 900 F, reduced their consumption of coke to something like 22½ cwt for the ton of iron, and the question which presented itself to their minds was, supposing the absence of any mechanical difficulty, how far this enlargement of size could be profitably carried, i.e., would a further increase of dimension be followed by a reduction in the consumption of fuel, or would it merely enable a larger quantity of iron to be smelted in a given time?

"In the absence of all systematic investigation of the real nature of the required conditions in smelting iron, before the end of 1868 furnaces were erected of enormous dimensions, the largest being those at Ferryhill, 103 ft high, and containing upwards of 33,000 cu ft.

"The first public attempt to examine the subject scientifically was made by Mr. Charles Cochrane, before the Society of Mechanical Engineers in November, 1868. In the paper read before this body, it was pointed out that the actual quantity of coke necessary in a blast furnace was that demanded for the reduction and carburizing of the iron, which he estimated at 7.43 cwt per ton of metal, and Mr. Cochrane himself having, in the meantime, had great experience with air, heated by means of Cowper's stoves, had applied it to furnaces having a capacity of 20,624 cu ft. In the discussion which followed the reading of his communication, he expressed a hope that by increasing still further the dimensions of the furnace enough heat might be conveyed into the furnace with the blast to enable a ton of iron to be produced from Cleveland stone with 13 cwt of coke.

"At the same meeting, I communicated shortly the reasons which prevented my agreeing with the opinions expressed by Mr. Cochrane, and these were extended in the same year in a paper read before the members of the Iron and Steel Institute, entitled 'The Development of Heat, and its Appropriation in Blast Furnaces of Different Dimensions.'

"The information contained in this communication was chiefly that derived from observations made on the furnace itself, and then it was that I became aware how much there remained to be learned of the laws which regulate the process of iron smelting before any one could look into the future history of the operation with any degree of certainty. Under these circumstances, I commenced at once a very long series of experiments to determine, if possible, the nature of the reactions which take place among the substances dealt with in the manufacture of pig iron."

This history therefore provides four starting points dated, 1868–1874:

1. Production—80 net tons per day.
2. Hot blast temperature—1000 F.
3. Coke rate—2000 lb per net ton.
4. Volume of furnaces—up to 40,000 cu ft.

Productivity, as quoted by Mr. Bell, increased during these years of experimentation, but due to the low iron content of the sandstones used, the rates seem low when compared to the present day English practices. Calcination of ores in those days was common, so it is very evident that beneficiation was started 100 years ago.

The beginning of the use of hot blast also stirred up controversial ideas, but the trend was started to save

fuel by increasing temperatures and reducing fuel rates.

It is also interesting to note that in some cases, furnace height was decreased to improve results, but the following increases in volumes are quoted:

1. Furnace No. 6—Clarence Works—25,400 cu ft.
2. Furnace No. 9—Ferryhill—33,000 cu ft.
3. Ormsby works (90 ft high)—40,000 cu ft.

Changes in dimensions of the furnaces during this period, 1868 to 1871, were rapid and many experiments were conducted to prove progress. Inspiration must have been the key to make the operators think out new ideas. Again quoting Mr. Bell:

"I am by no means prepared to deny that up to a certain capacity, shape in a blast furnace may be very important, and I am, therefore, prepared to accept any properly authenticated statement, either that Alger's elliptical furnace of Rachette's oblong one may be very useful. It must, however, be borne in mind that all the changes in form just referred to as having beneficially affected the furnaces upon which they were made were applied in instances when the duty performed was greatly below that attained in more recent times, in furnaces sufficiently large. If later improvements have enabled us to deprive the gases of as much of their sensible heat as is practicable, and at the same time to exhaust their reductive power, I for one must decline believing that either of these offices can be sensibly altered by a mere change in the shape of the vessel in which they are carried on."

During his 25 years of service, Mr. Bell certainly contributed correlating facts as evidence to prove the soundness of the progress made during these years.

PRESENT PRACTICE

Factual maximum results obtained by furnaces in the United States and Canada indicate that much progress has been recorded in the last 18 months. The utilization of increasing volumes of beneficiated materials is now producing expected results within this year and, by the end of 1960, another increase in the volume of available beneficiation will come into furnaces that will produce higher tonnages and lower fuel rates.

In 1958, several furnaces approached and also exceeded an average of 2400 tons per day. Fuel rates were reported less than 1250 lb per ton. Blast temperatures in excess of 1600 F were used along with controlled moisture to regulate both chemistry and stock travel. It should be emphasized that the combination of beneficiation (which includes coke and limestone as well as ore) with higher blast temperatures in a well designed plant has caused a sharp slope upwards during the past 18 months.

It also should be pointed out that furnace volumes or heights have not been increased in proportion to the tonnage increases during the past 100 years when comparing to the data from Mr. Bell's book. However, working lines have been altered to improve gas flow patterns resolved by the use of better raw materials. It is quite evident that the 28-ft hearth furnace with a working volume of 48,000 cu ft is producing 2400 tons per day. Lime bearing or self-fluxing sinter is also helping to improve tonnages and coke rates.

New and modern sintering plants are now in use. Some are in the so-called break-in periods at the present moment, but improvements in practices are evident in every case. The technical problems that are being encountered in using limestone and dolomite seem to be fairly well solved as continued progress has been reported in several plants. It could be stated that American engineering together with "patient" operators are working together to produce excellent results. The realization of investment costs certainly seems to be well in hand in the preparation of new burdens.

Pellets also are the means to the same ends—higher productions. Reports certainly indicate that the same high tonnages and low coke rates are being produced, viz., 2400 tons plus per day with correspondingly low coke rates.

In summary, the results obtained up to the present time are the result of complete beneficiation, which includes:

1. Screening and sizing of ores.
2. Normal sintering plus proper sizing.
3. Lime or self-fluxing sinter.
4. Strong and uniformly sized pellets.
5. Sized and cleaned fluxes.
6. Sized and strong coke.

It also is very apparent that good furnace lines plus blast temperatures of 1600 F have helped to produce these high tonnage rates.

THE FUTURE

A look into the future, based upon two points in the curve and extended upwards at a steeper angle than during the past 90 years, may be calculated to be easily attainable if the following suggestions are carried out:

1. Provide provisions for a minimum of 1800 F blast temperatures.
2. Provide facilities that furnish and record blast analysis with controlled additions of moisture and hydrocarbons.
3. Provide necessary equipment to furnish high top pressure operation.
4. Provide instrumentation and regulation for the following:
   a. Automatic stove changing.
   b. Thermocouple recorders in critical areas.
   c. Iron and slag temperature recorders.
   d. Immediate chemical determinations.
   e. Gas analyses recorded continuously.
   f. Continuous record of weighed amounts of burden.
   g. Weather station teletype for furnace operators (especially for humidity).
5. Provide complete automation for cast houses:
   a. Automatic tapping hole opening remotely controlled.
   b. Remote control for iron and slag runner gates, etc.
   c. Semi-permanent type refractories for runners.
   d. Motorized high lift type machine to handle blow pipes, tuyeres, coolers, etc.

e. Proper flow meter alarms for water, steam interruptions.

6. Provide as much automatic filling equipment as possible for stock houses, skips and furnace tops. Several furnaces now fill coke, limestone or sinter through weigh hoppers. It should be possible to fill some burdens completely by belt systems, vibratory conveyors and remotely controlled scale cars.

SUMMARY

Two curves have been plotted to show the progress that has been made during the last century. The tonnage curve up to the present time is on a gradually increasing uniform slope up until 1955, as shown by the points No. 1 and No. 2. From the No. 2 point upwards to No. 3 point, the steeper slope indicates much faster progress during the past four years. This is attributed to the increase in volume of available beneficiation.

The coke rate curve shows the pattern to be more pronounced in slope angles. During the first part of the century, the flatter portion is more gradual, but continuing progress is noted between points No. 1 and No. 2. The decided increase in slope from 1955 to 1959 is again the direct result of beneficiation plus higher blast temperatures.

Portions of both curves after 1959 are estimated, assuming that further increase in volumes of sized ores, sinter and pellets will be accomplished as planned by most steel companies.

Part of the background for the "estimated" steeper slopes after 1959 was furnished from laboratory work which is in progress. It is felt that when these results are put into large scale operations that the slopes are conservative.

Also, the use of hydrocarbons in the blast also seems practical. From several preliminary test runs, the predicted volumes of iron together with low fuel rates go hand in hand and could easily provide an additional assist in promoting general progress.

Discussion

PRESENTED BY

W. J. REILLY, General Manager, Steel Mill Div., Ford Motor Co., Detroit, Mich.

D. P. CROMWELL, Associate, William M. Bailey Co., and Associate Professor, University of Pittsburgh, Pittsburgh, Pa.

W. H. COLLISON, Plant Superintendent—Blast Furnace & Coke Works, Great Lakes Steel Corp., Div. of National Steel Corp., Ecorse, Mich.

W. J. Reilly: Does the bottom part of the curve on coke consumption indicate around 500 lbs per ton?

D. P. Cromwell: Right.

W. J. Reilly: What is that usage going to do to the iron analysis, especially in respect to carbon, perhaps silicon? What effect is a much lower carbon iron going to have on the smelting or steelmaking processes?

The relationship of iron and scrap in the melt process might be greatly affected by a very radical change in the analysis of pig iron. What do you guess it would be?

D. P. Cromwell: I firmly feel that if you use a gas reduction process that you must make the pig iron specification the open hearth desires and gets, on the average. However, getting back to your question of the 500 lb coke rate, I can see no reason why the furnace cannot be burdened with a higher Fe in the burden, and the proper relationship to silicon must be taken out of the burden, your slag calculated as done in the past. You should be able to do it without any more trouble than you have now, and come out with specification pig iron.

W. J. Reilly: What will be the carbon content?

D. P. Cromwell: I do not think your carbon content will change as long as you keep the silicon up where it belongs.

W. J. Reilly: Where are you going to get it?

D. P. Cromwell: From the same place, out of the coke.

W. J. Reilly: Where are you going to get it in this pig iron if you go to 500-lb coke against 1700?

D. P. Cromwell: Your carbon ratio can be figured back with the amount of slag that will be produced. You put the silicon in the iron in the same ratio you do it now.

W. J. Reilly: Why not make it lower so we do not have so much to take out?

D. P. Cromwell: I will say this in defense of the blast furnace man, if the open hearth gets a standard specification and sticks with it, we will make it.

There are some of these facts and figures I am not at liberty to present in defense of this low amount of coke.

It is quite a well known fact that we have research laboratories that have almost doubled in size in the last three or four years. Some of the results that are coming out of some of these new laboratories are very stimulating. I have reference to some of the work that is being done to convert hematite or magnetite into other products of much higher iron content.

It is being done, and I have every reason to believe that in the next year or two there will be some other plants built that, instead of having pellets or sinters of around 60 to 64 per cent Fe, they will get up to around the 70 per cent mark.

Now, if you put a burden on a blast furnace, with some 70-odd per cent Fe in the burden, by extrapolating this term, is how we found the slope on this curve. Remember, however, we said the time phase is one that had to be estimated. I do not think we are guessing at the amount of Fe that is going in the burden that goes into the blast furnace. It closely resembles what happens in a cupola.

The increases in volume in the new furnaces being built is going to help some, but not nearly as much as increasing the iron in the so-called beneficiation of burden as much as one or two per cent. The volume has an effect absolutely, but not as much as increasing the iron content of the beneficiated burden, such as say five per cent.

Again in defense of this curve, we certainly think that history will repeat itself.

W. H. Collison: Mr. Cromwell has presented some trends on blast furnace operation which are quite thought provoking.

Recently we at Great Lakes increased the sinter in our furnace burden considerably, and also started the

use of self-fluxing sinter. We have no doubt about the general increase in iron production with beneficiated burdens, but production rates, wind rates, coke rates, dust rates and blast pressures were disappointing at times. Our situation seems to be similar to that reported by Messrs. Hill and Epstein of Bethlehem Steel Co. reporting on the use of sinter in the plants of that company. They reported contradictory results with the conclusion that variable physical properties caused the varying results.

It seems that much attention must be given to the uniformity of physical properties, size and clean screening, not only of the sinter but also the coke and any other charge materials.

If we are to have coke rates as low as 500 lb per ton, the use of some other heat source than the sensible heat of the blast air is necessary. The United States Bureau of Mines has performed some experiments with natural gas as an auxiliary blast furnace fuel with interesting and apparently significant results.

We have heard that a furnace in this area has used natural gas experimentally. I would be greatly interested if we can have comments on that operation.

D. P. Cromwell: Let us take magnetite for a minute. Actually from the chemical values, it contains 72.4 per cent Fe and 27.6 per cent oxygen.

Now, if that metallurgical compound magnetite is 90 per cent of your beneficiation, say, as in a pellet, and you decrease the oxygen content by outside means from 27½ per cent to 13.8 per cent, in other words take half of that oxygen out before you put it in the blast furnace, then the iron content in that particular form, assuming that 90 per cent of that compound is a magnetite and the other 10 per cent is silica, aluminum, magnesium, lime and so forth, and all the other elements you find, that your new percentage of iron in that compound comes up to 77.58 per cent Fe in the pellet.

Now, we figured a couple of burdens in which this new iron content was used and we came up with the increases in productions as shown on the curve.

Now, on the use of hydrocarbons, I do not know whether there is anyone here that wants to talk about it or not. I did hear the figures on the experimental furnace of the United States Bureau of Mines three or four different times, in which they quoted that the furnace is operating on sinter normally while producing iron at 1300 lb of coke, but with an eight per cent natural gas addition, the coke rate decreased to 900 lb using a blast temperature of 2300 F to start with, but with some moisture in the natural gas. That is about all that I have heard on that particular operation.

I happen to know there are a couple of other furnaces being equipped to make hydrocarbon experiments this summer, one of them on coke oven gas, and the thermal effect figures on coke oven gas versus natural gas should give like results. ▲

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ELPIT electric soaking pits supplement fuel-fired pits in English Mill shown above.

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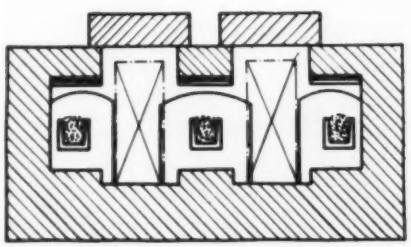

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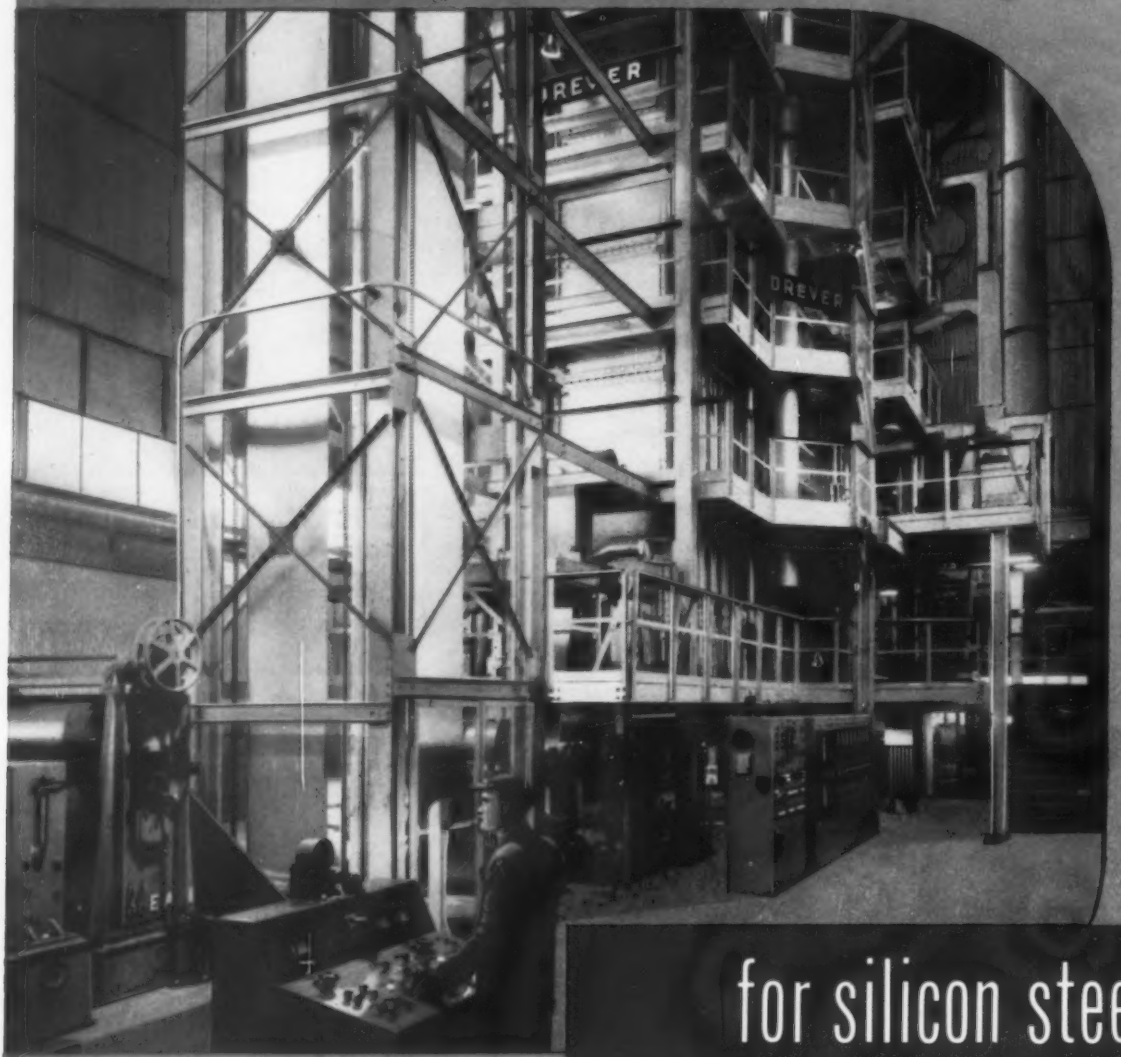

for silicon steel

Delivery end of Drever gas-fired radiant tube heated vertical annealing furnace for silicon steel strip installed at Empire Steel Corporation, Mansfield, Ohio.

This furnace was designed and installed by the Drever Company to produce 8 tons per hour of silicon steel strip. The heating and soaking zones are gas-fired radiant tube heated; the tubes having a connected load of 13,500 CFH of natural gas.

The furnace has been engineered to handle silicon steel strip in thicknesses from 0.017" to 0.025", in widths from 24" to 42", and for speeds from 60 to 180 FPM.

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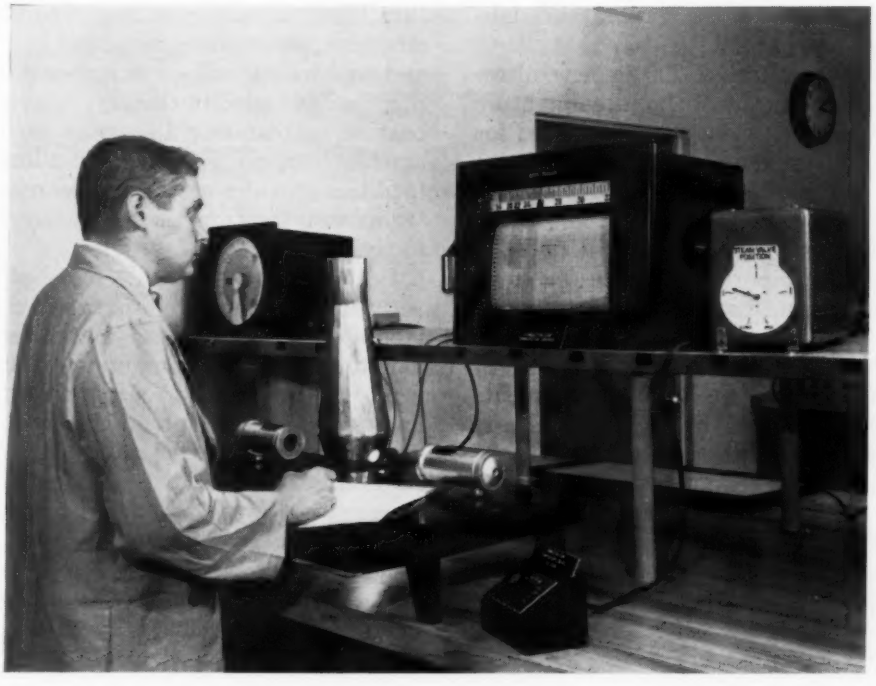
Figure 1 — The nerve center of all research activities carried on by United States Steel Corp. is the research center at Monroeville, Pa. The aerial view shows the new electromechanical building at right.

U. S. Steel Dedicates Electromechanical Laboratory

THE new electromechanical laboratories officially opened on May 18, 1960, at United States Steel's Monroeville, Pa., Research Center, will have far-reaching effects on the steel industry.

These new laboratories will be dedicated to the development and application of control systems for new and existing processes in all steelmaking functions and will search for better methods of controlling the chemical and metallurgical properties of products. This aim should first, obtain higher quality, and second improve yield.

Figure 2—Electromechanical research is attacking the problem of developing instrumentation which will provide valuable information to the ironmakers on what really goes on in a blast furnace during the ironmaking process. In addition, the studies are designed to explore the field of automatic controls for such variables in the blast furnace operation as moisture, air and fuel injection. Figure shows temperature changes being tabulated as recorded on the instrument centered on the table above the small blast furnace model. On either side of the furnace are miniature radiation devices aimed at tuyere peepholes at the base of the furnace. Full-scale blast furnace experimentation of the type seen here is presently under way at U. S. Steel's Edgar Thomson works.



The electromechanical research will also work on projects ranging from problems in material handling to the development of automatic devices designed to control temperature of furnaces, thickness of product and so forth.

For example, in raw materials, there is interest in developing methods for the continuous sampling and analysis of iron ore and then in automatic measurement of its weight and rate of flow.

In ironmaking, basic to all steel industry operations, the electromechanical group has much interest in the design of the controls and instrumentation which will go into the research center's new pilot blast furnace. This furnace, scheduled for completion in the fall of 1960, will be the most advanced of its type in the world.

In the area of inspection, U. S. Steel is working on new or improved quality-guarding devices.

Electromechanical research is a division of the Research Center's Applied Research laboratories. In addition to applied research, U. S. Steel also has fundamental research facilites. Together they employ a combined total of some 1100 scientists and their supporting personnel and cover more than 580 different research projects.

U. S. Steel's Monroeville research center personnel are concerned with many problems in addition to elec-

Figure 3 (left) — Magnetic properties of a steel sheet passing through a measuring coil are indicated numerically on the meter (center background). A low number means that the test sheet is a high quality steel. This reading is then shown as an image inscribed by two vertical lines appearing on the scope above the technologist's shoulder, a design which he calls "the fingerprint of steel." Magnetizing coil units of this sort, installed directly on production lines in U. S. Steel plants, will improve existing methods of quality control and will permit an immediate classification of steel into grades.

Figure 4 (right) — Electromechanical lab technician operates a model which demonstrates how steel I-beams can be measured prior to sawing in order to eliminate waste. With electronic speed, this measurement is tabulated and noted on digital computing equipment (similar to that behind the model above) in the mill's hot saw area before the I-beam arrives for cutting into precise lengths according to specific customer orders. Here, shearmen consult the digital indicator for the length of each beam as it enters the hot saw area and check this measurement against orders. Then, to minimize waste, the I-beam is cut into segments, the number depending upon the beam's original length and specific customer requirements. A measuring system, based on this very experiment, has been operating for six months in the structural mill of U. S. Steel's South Works, Chicago.

tromechanical research. In the area of products, they are working on such things:

1. Thin tin, a new light weight tinplate that promises to revolutionize can manufacturing.

2. Development of suitable new steels for missiles, space vehicles and manned aircraft. One new stainless steel, still under extensive tests, has shown a room temperature tensile strength of 250,000 psi—higher than any similar competitive steels, more than four times the strength of ordinary carbon steel.

3. Important studies are being carried on in co-operation with the Atomic Energy Commission and private companies, on various types of steels including new high-strength, low-cost steels for high temperature use in nuclear reactors.

Two products which have recently emerged from the corporation's laboratories are:

1. Airsteel X-200, a new ultra-high-strength at high-temperature alloy steel which was developed for missiles and rockets.

2. Vinyl-coated steel, used extensively in the construction of the electromechanical building.

Also important are the improvements in existing products made possible by applied research effort. This work has led to new types of steel coatings, chemical treatments and improved tinning of steel and great improvement in the purity of the corporation's coal chemicals.

In effect, U. S. Steel's applied research program embraces a complete pilot scale steel mill with its sintering line for research into iron ore beneficiation; a coking plant; chemical recovery plant; a miniature blast furnace now under construction; steelmaking furnaces; hot and cold rolling mills; vacuum casting facility; electro-tinning; vinyl coating, galvanizing lines and enameling furnaces. Each of these pilot facilities provides scores of research teams with the equipment necessary to their effort.

In addition to the wide scope of activity carried on by the applied laboratories, there is an extensive long-range research program under way for the purpose of obtaining knowledge needed for advances in various phases of steel technology. As examples, basic or fundamental research is carrying on studies into the mechanisms and kinetics of the reduction of iron ore, and studies are also being carried out on basic factors that determine strength and toughness of steel. ▲

DESIGN FACTS ABOUT ARC-CAST MOLYBDENUM

CORROSION PROBLEMS:

can moly metal's resistance to mineral acids solve them for you?

The following tables show molybdenum's resistance to corrosion by mineral acids, providing oxidizing agents are not present. They also indicate molybdenum's superiority to conventional materials used in handling these acids.

hydrochloric acid

% HCl	temperature, F	aerated	corrosion rate, mils/year* unalloyed molybdenum	14% Si – 3% Mo iron	70% Ni – 30% Mo alloy
5	room	yes (air)	0.40	–	7.8
		yes (oxygen)	0.27	–	–
	160	no	1.1	18.	13.
		yes (oxygen)	1.4	17. (air)	25. (air)
	boiling	no	3.6	79.	13.
20	room	yes (air)	0.10	–	3.1
	160	no	0.58	35.	9.2
		yes (oxygen)	1.4	53. (air)	24. (air)
	boiling	no	0.90	230.	27.
37	room	yes (air)	0.16	–	1.6

*average of five 48-hr periods

hydrofluoric acid

% HF	temperature, F	aerated	corrosion rate, mils/year* unalloyed molybdenum	70% Cu – 30% Ni alloy
25	room	no	0.13	2.6
		yes (air)	0.22	–
	212	no	3.1	55.
		yes (air)	20.	–
49	room	no	0.14	4.1
		yes (air)	0.08	–
	212	no	2.3	75.
		yes (air)	16.	–

*average of five 48-hr periods

phosphoric acid

%H_3PO_4	temperature, F	aerated	corrosion rate, mils/year* unalloyed molybdenum	type 316 stainless steel	70% Ni – 30% Mo alloy
10	room	yes (air)	0.27	nil to 0.18** (oxygen)	1.7
	212	no	2.4	nil to 0.18**	24.
	boiling	no	1.3	nil to 6.7**	19.
50	room	yes (air)	0.25	nil to 0.06** (oxygen)	0.40
	212	no	1.5	1.7	2.5
	boiling	no	1.5	5.4	7.1
85	room	yes (air)	0.20	nil to 0.80** (oxygen)	0.16
	212	no	0.29	20.	0.83
	boiling	no	1.4	770.***	1.9

*average of five 48-hr periods
**range of five 48-hr periods
***one 48-hr period only

sulfuric acid

%H_2SO_4	temperature, F	aerated	corrosion rate, mils/year* unalloyed molybdenum	14% Si iron	14% Si – 3% Mo iron
10	160	yes (nitrogen)	0.22	–	–
		yes (air)	1.4	–	–
		yes (oxygen)	nil to 9.1**	–	–
	boiling	no	6.6	–	–
	400	no	0.77	–	–
20	160	yes (nitrogen)	0.18	–	–
		yes (air)	0.82	–	–
		yes (oxygen)	nil to 3.4**	–	–
	400	no	3.7	–	–
40	160	no	0.74	11.	2.9
		yes (air)	nil to 0.90**	10.0	–
		yes (oxygen)	nil to 1.4**	–	–
	boiling	no	1.5	14.	6.7
50	160	no	0.52	3.4	0.36
		yes (air)	nil to 0.52**	2.3	–
	boiling	no	2.5	5.9	1.6
75	160	no	0.70	0.13	0.20
		yes (air)	nil to 0.15**	nil	–
	boiling	no	34.	0.26	0.68
95	160	no	0.12	0.02	0.28
		yes (air)	nil to 0.21**	0.36	–
	boiling	no	dissolved	–	–

*average of five 48-hr periods
**range of five 48-hr periods

Molybdenum also offers good long-term resistance to attack by liquid metals up to the temperatures given: bismuth (2600 F), gallium (570 F), lead (2190 F), lithium (1650 F), magnesium (1290 F), mercury (1110 F), potassium (1650 F), sodium (liquid and vapor) (1650 F), sulfur (825 F) – and a number of alloys of these and other metals.

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Figure 1 — Hot strip passes to left from finishing stands out of sight on right. Infrared radiation pickup head (upper right) is hermetically sealed, water cooled and shock mounted. It senses width deviations to a minimum accuracy of 1/8 in.

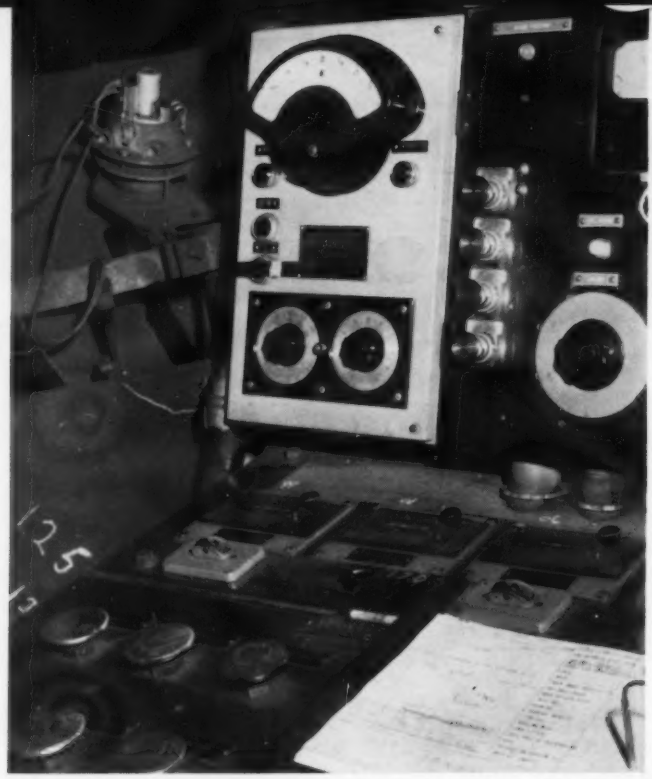


Figure 2 — Operator control panel in roller's pulpit shows wide scale width deviation indicator, indicator lights for power and water for gage head cooling, and dials for setting nominal width. The setting shown is for strip 24 7/8 in. wide.

Width Gage Increases Hot Strip Yield

AN infrared width gage on the $26,000,000 hot strip mill at Butler, Pa., is cutting steel strip costs for Armco Steel Corp. Improved yield is Armco's biggest advantage in using the gage. It helps eliminate waste and avoids necked-down sections that could mean a loss of about two in. in slitting the strip.

Armco's aims in installing the gage were twofold: (1) to insure top economy by preventing excessive trimming on the more than 80 grades of stainless and electrical steel strip rolled on the 54-in. mill; and (2) to set up a fast method of continually measuring, at close tolerances, the width of strip coming from the finishing stands at 1300 to 1700 fpm.

The heat radiation gage is non-contacting and operates from an infrared sensing head mounted above the moving strip, continuously scanning every inch of width. Highly accurate and responsive at strip speeds up to 2000 fpm, it operates even when strip edges are below the color range, registering as long as edge heat is 900 F or more. As long as sufficient radiation is reaching the gage head, even steam and oxide dust have no effect on its operation. Sidewise strip movements of as much as 3 in. on each side will not affect accuracy of the gage, and there is also no adverse effect when speed changes are introduced. The complete width gaging system, designated Infra-Ray, is manufactured by Weston Instruments Division of Daystrom, Inc.

The gage head is mounted in a water-cooled, heavy steel housing about 14 ft above the strip bed and just beyond the last of the mill's six finishing stands. A permanently-lubricated, ball-bearing motor shaft is the only moving part.

When steel is running, the head continuously transmits its measurement signals to console equipment for translation to visual indication at the finishing stand control station, speed pulpit and roughing stands. The roller in the control pulpit can read any deviation from nominal width on a large scale, zero-centered meter. The meter indicates a width range of ±1 in.; increments on the scale are 1/8 in., which is the guaranteed accuracy of the gage. The roller's control panel also contains dials for desired width settings and indicator lamps for power and the water used to cool the gage head.

A floor-mounted main console is used to house all operating circuitry on unitized tilting chassis, as well as voltage regulating equipment and the necessary disconnects.

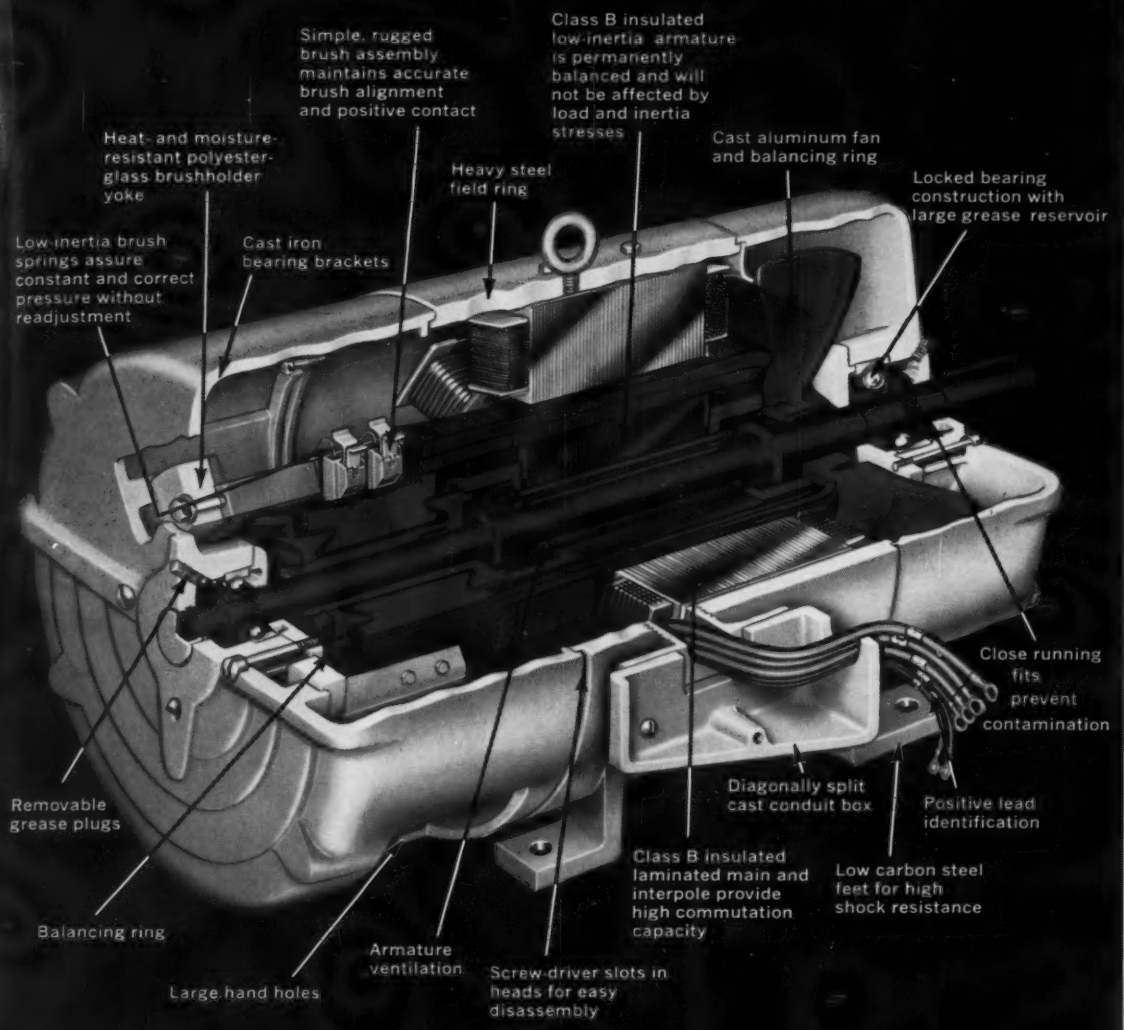
When periodical calibration for the various sizes of strip is necessary, the gage head is positioned over a calibrating unit which simulates various strip widths with infrared lamps.

The gage has been a great help in quality control. Previously, a means for measuring width on a continuous operation was lacking. The least representative portion of a length of strip, the end, was the only part that could be measured. Using the gage, the speed operators can vary the rate of rolling on the finishing stands and thus control width.

Before using the gage, blame for width variations used to fall solely on the speed operator, but the gage proved that mills before the finishing stands sometimes introduced unwanted changes.

Armco's 54-in. mill, which was installed in 1958, can take a hot slab of steel 6 in. thick and 210 in. long and roll it down as thin as 0.072 in. ▲

Here's the latest in D-C motor design:

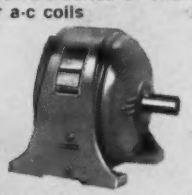

Simple, rugged brush assembly maintains accurate brush alignment and positive contact
Class B insulated low-inertia armature is permanently balanced and will not be affected by load and inertia stresses
Heat- and moisture-resistant polyester-glass brushholder yoke
Heavy steel field ring
Cast aluminum fan and balancing ring
Locked bearing construction with large grease reservoir
Low-inertia brush springs assure constant and correct pressure without readjustment
Cast iron bearing brackets
Close running fits prevent contamination
Removable grease plugs
Diagonally split cast conduit box
Positive lead identification
Class B insulated laminated main and interpole provide high commutation capacity
Low carbon steel feet for high shock resistance
Balancing ring
Armature ventilation
Large hand holes
Screw-driver slots in heads for easy disassembly

...and some easy-to-add field modifications

A-c tachometer for speed indication

A-c motor-driven blower with permanent dry-type filter for easy mounting on bearing bracket

Magnetic disc-type brake with d-c series or shunt, or a-c coils



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New Louis Allis FLEXITORQ® D-C MOTORS

...offer you vastly improved commutation–low brush wear–400% short-time overload capacity–and unmatched flexibility!

Bear this in mind: The Flexitorq is *not* just another *rerated* d-c motor. It's *all new*—and it's been designed to give you more for your power dollar — in superior performance, matchless field flexibility, and unrivalled economy of operation and upkeep.

Advanced armature design and brush construction offers improved commutation, faster response, and lower brush wear. Class B insulation system provides exceptional thermal endurance . . . is rated for 60°C rise for continuous duty . . . and creates a barrier to moisture, acids, alkalis, and other contamination.

The net result to you is reliable, trouble-free power for constant and adjustable speed drives. For example, Flexitorq gives you 400% faster acceleration, plus much better deceleration, reversing, and speed changing. You can safely impose 400% intermittent and 15% continuous overloads — and the high-torque design is a welcome plus when you need extra power for hard-to-start machines.

The new Louis Allis Flexitorq is lighter and more compact than previous d-c motors . . . lets you squeeze more power into less space . . . yet is actually *easier* to service! Brushes and entire brush-holder assemblies can be quickly inspected and removed without major disassembly. And since brush springs remain conveniently attached to the brush holders, brush changing is a simple affair.

Flexitorq d-c motors are available in sizes from 1 to 400 hp — in various enclosures. See your nearby Louis Allis District Office for information and application help. Or write for Bulletins 3150 and 3200 to The Louis Allis Co., 450 E. Stewart St., Milwaukee 1, Wis.

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MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

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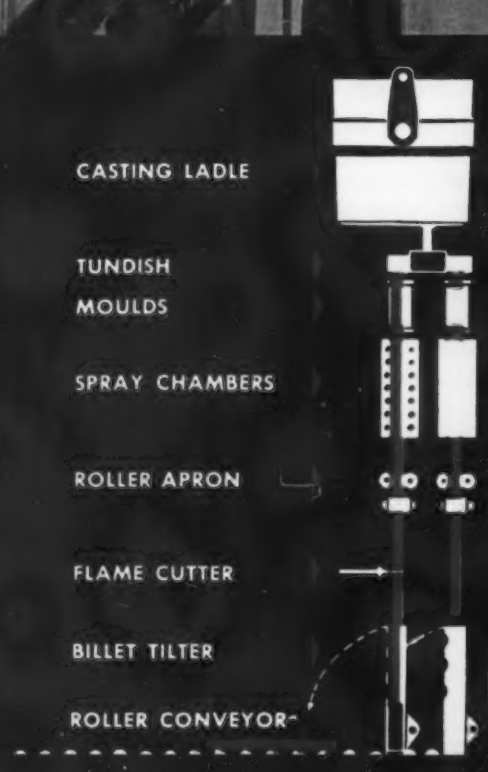

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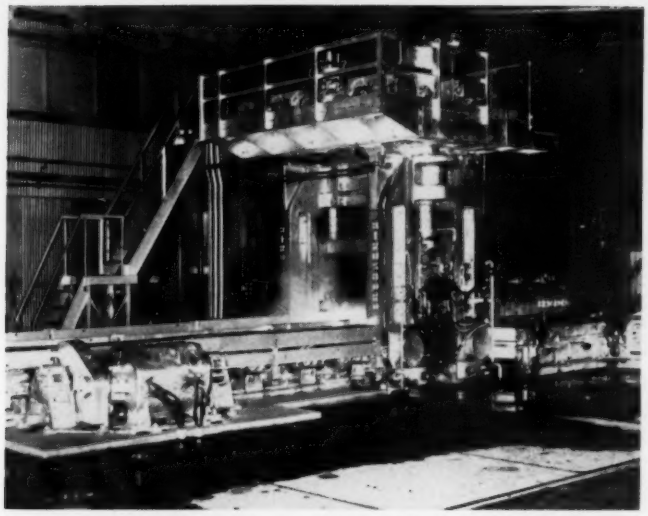

Figure 1 — New blooming mill installed at Riverdale, Ill., plant of Acme Steel Co.

Acme Steel Installs 32-In. Blooming Mill at Riverdale

A NEW 32-in. two-high reversing blooming mill was installed by Acme Steel Co., as part of the recently completed steelmaking facilities at its Riverdale, Ill., plant. The mill stand and its associated handling equipment, engineered and built by Birdsboro Steel Foundry and Machine Co., roll a broad range of products from large blooms to small billets.

The roll stand is driven by a 6,500-hp, 60 to 140-rpm main mill motor through a pinion stand and universal spindles. The work rolls have a new diameter of 35-in. with an 80⅞-in. long body. The roll necks are 20-in. diam and run in water-lubricated fabric bearings.

The top roll screwdown moves the top roll at a speed of up to 97.5 in. per min. The screws are 12-in. diam driven by two 75-hp mill motors through a gear train and worm gear sets. Special provisions are made to permit unjamming the screws with the use of a crane when necessary. A clutch is provided in the screwdown drive to facilitate levelling the top roll. Maximum opening with new rolls between the top and bottom roll bullhead is 30¼.

The top roll is held against the screws by mechanical counterbalances and the chucks are carried in a roll rider which remains in the mill when rolls are changed. The roll rider carries bronze thrust bearings with spherical seats against which the screws turn when the top roll is being adjusted. This rider is fitted with replaceable liners which run against hardened steel liners held in the housing windows by through bolts. The housing windows are also lined where they bear against the sides of the bottom chucks. The bottom chucks are carried on a roll changing sled which rests on hardened liners in the bottom of the housing windows.

The roll stand is equipped with two 15-in. diam forged steel feed rollers, each driven by a 15-hp mill motor. The anti-friction bearing cartridges for these rollers are mounted so that all clearance between the roll stand housing bores and cartridges can be removed by adjusting a split tapered sleeve.

The new equipment includes a 26 ft long front reversing mill table. The table has eleven 15-in. diam by 7 ft 3¼ in. long rollers, on 2 ft 2-in. centers journaled in anti-friction bearings, driven by two 75-hp mill motors working through a gear drive and a common line shaft.

The table is fitted with side guard manipulators, the driving rams for which run on rollers, equipped with anti-friction bearings, mounted in the table base. Gear racks are fitted to the underside of the side guard rams and the racks for each side guard are driven by pinions mounted on a common shaft. Each side guard is powered by two 35-hp motors working through a gear drive to turn the rack pinion shaft.

The side guard on the pinion side of the mill is equipped with a finger lift. The finger lift is actuated by a crank drive, all of which is mounted on and moves with the side guard. The fingers have a lift of 18½ in.

The moving side guards are 28 ft-4 in. long. Both the manipulator drive and the screwdown are lubricated by a circulating oil system. ▲

Extensive New Facilities Scheduled to Produce Oxygen

AN increase of 4000 tons per day in the oxygen producing capacity of Linde Co., Division of Union Carbide Corp. will result from presently scheduled expansion of facilities at sixteen locations throughout the country. This program is a continuation of the accelerated expansion of recent years wherein Linde has been placing new oxygen plants "on stream" at the rate of one per month since 1955. Of particular significance is that the current expansion amounts to more than 20 per cent of the total presently installed United States production capacity for oxygen, of which most of the new capacity will serve the rapidly growing requirements of steel producers. Among the steel companies with whom negotiations have recently been completed to satisfy new requirements are Bethlehem Steel Co., National Steel Corp., Republic Steel Corp., U. S. Steel Corp., Colorado Fuel & Iron Corp., Armco Steel Corp. and Detroit Steel Corp.

The current program includes approximately $50,000,000 worth of new on-site, or over-the-fence, plants to produce gaseous oxygen at the point of use. These plants are owned and operated by Linde and do not require capital investment on the part of the customers they serve. At the present time, Linde is competing for contracts to build on-site plants at many additional locations. Competition is very active and nearly 100 companies are now in the oxygen-producing business.

Among Linde's new facilities is the largest on-site plant ever built for the steel industry—with capacity to produce 1000 tons per day of high-purity oxygen. This plant, which will go "on stream" early in 1960 is at the Duquesne Works of U. S. Steel Corp. It will also serve three other U. S. Steel facilities in the Pittsburgh area. Oxygen will be supplied to mills at Braddock, McKeesport and Munhall, Pennsylvania, through the first interurban oxygen pipeline in the country. All of these locations are now served by individual Linde plants. Three of these will be moved to other locations and the fourth, which is producing over 400 tons per day of low-purity (95 per cent) oxygen for use in ferromanganese furnaces at the Duquesne Works, will remain in its present service.

The smallest of the new facilities will be built at Cincinnati, Ohio, to provide oxygen for Emery Industries' chemical processes. It will produce 30 tons per day of high-purity gaseous oxygen to be converted by Emery to ozone.

Other new plants for specific customer requirements are being built at Gadsden, Alabama, with capacity of 85 tons per day; Pueblo, Colorado, 280 tons; Chicago, Illinois, 140 tons; Buffalo, New York, 320 tons; Detroit, Michigan, 500 tons; Gary, Indiana, 135 tons; Cleveland, Ohio, 280 tons; Middletown, Ohio, 140 tons; Portsmouth, Ohio, 140 tons; Morrisville, Pennsylvania, 140 tons and Charleston, West Virginia, 85 tons.

These capacity increases reflect industry's increasing demand for oxygen. Taking the steel industry as an example, at several locations presently being expanded, the installed on-site plants can no longer supply the demand, which has increased about 300 per cent in a period measured in months. At one location, there has been a 900 per cent increase.

Each of the on-site plants is designed to meet the customer's estimate of his oxygen needs. However, in the event of temporary shutdowns or demand surges, additional oxygen is supplied from massive liquid oxygen plants at Linde's central locations. With the growth of on-site plant service, a complementary increase in liquid-producing capacity must, therefore, be provided. Included in Linde's 4000 tons per day of increased capacity are 450 tons per day of liquid oxygen and nitrogen capacity at new central plants in Huntsville, Alabama; Neosho, Missouri and Fontana, California. Further increases in liquid-producing capacity are in the planning stage.

Some of the new on-site oxygen plants can be considered as important sources for the production of argon—a rare gas that is now used in increasingly large quantities in metal-fabricating processes and in providing a shielding atmosphere for the processing of reactive metals such as titanium. Modifications in equipment will permit substantial, additional volumes of argon to be produced. Linde intends to prepare and operate these argon facilities when market conditions are appropriate. ▲

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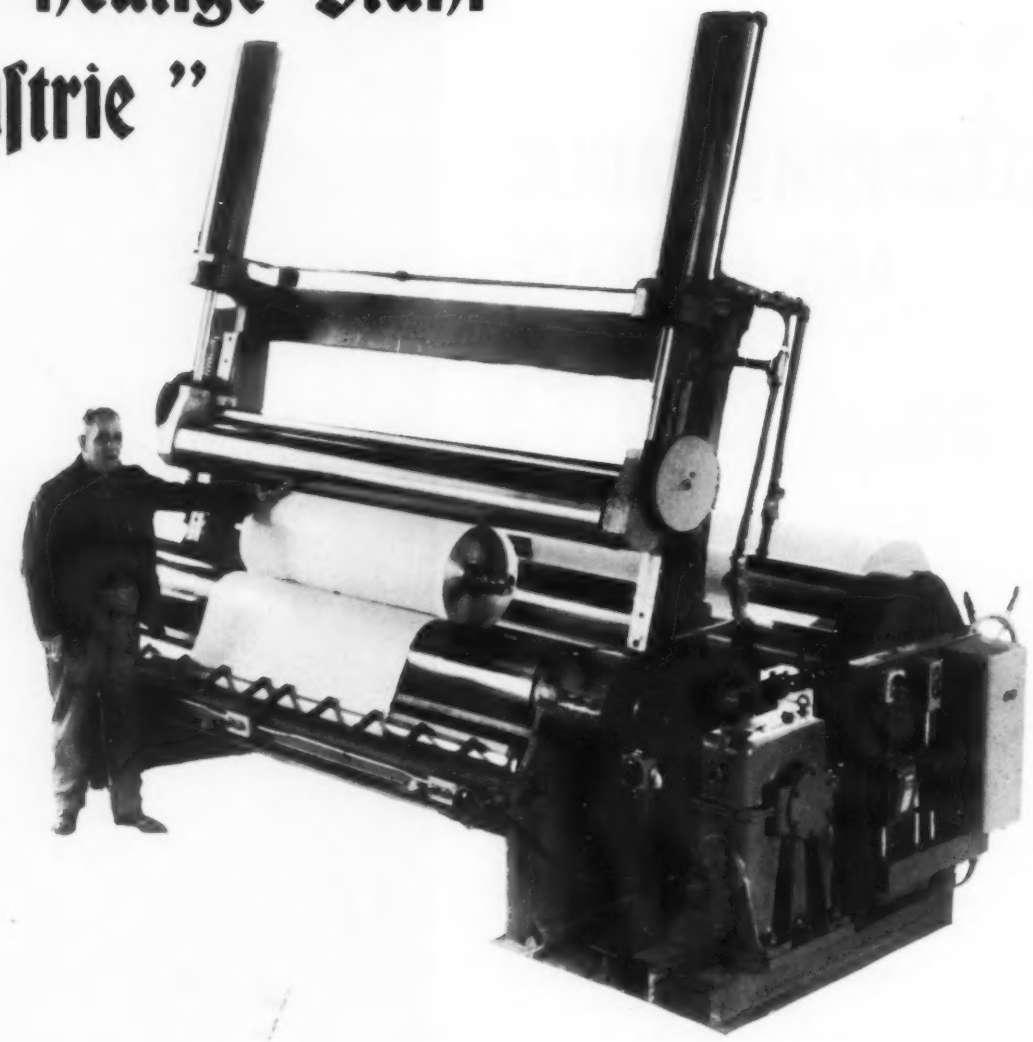
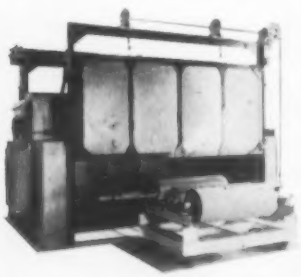


A combination of German craftsmanship and American ingenuity have, through Joseph Zimmermann, solved a problem suffered by the steel industries all over the world.

THE PROBLEM: conventional rollers on continuous electrolytic lines, galvanizing lines and annealing lines have a tendency to pick up bits of metal which mark the steel: they have to be continually watched, constantly cleaned, and far too often replaced—resulting in a waste of valuable production time and money.



THE SOLUTION: a new laminated *plastic coated* roller developed by Mr. Zimmermann of the Steel Plant Equipment Corp. With the precise care of German craftsmanship, and American equipment built to his specifications, Mr. Zimmermann can make these rolls from all the Nema Grade types of materials or any special grades specified by prospective customers and in sizes from 4" to 36" in diameter and up to 96" long.

These new plastic coated rollers have been proven by the steel industry all over the world to last from three to five times as long as the previous types of rollers, and to cut down-time to a minimum. As Mr. Zimmermann sums them up: these plastic covered rollers are . . . "the best rollers for the steel industry today."

STEEL PLANT EQUIPMENT CORP.

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Ford Reveals New Technique in OH Steelmaking with Oxygen

FORD Motor Co. has been experimenting with a new process for making open hearth steel that has the potential for reducing by one half or more the time required to make a ton of steel by conventional methods in the same furnaces.

The process is still in the experimental stage, and applies only to the production of steel ingots by open hearth furnaces. It does not affect the cost of scrap steel or hot iron, two of the basic ingredients in steelmaking, nor does it alter the cost of rolling and shaping steel for use in automobiles or any other product.

This is the first public disclosure of the Ford experiments. The Ford process is essentially a revision of the conventional open hearth method. It makes use of a combination of fuel and oxygen and substitutes burned lime for limestone in order to hasten the chemical and thermal reactions that convert the ingredients into molten steel.

In one of the furnaces used in Ford's experiments, the conventional process formerly required about 10 hr from the time the furnace was charged until the molten steel was tapped. This furnace had a capacity of 200 tons, and thus produced steel at a rate of about 20 tons per hour.

Throughout the history of steel making, ways have been sought to hasten the open hearth process or in some other manner to reduce the length of time required to carry it out. Substantial progress has been made in this direction by the steel industry recently through the addition of oxygen to speed oxidation and purification in the furnace. Ford's experience with these new oxygen techniques has been about the same as that of the steel companies using newly developed oxygen equipment. In the case of Ford's 200-ton furnace, these techniques increased the rate of output from about 20 to approximately 30 tons an hour.

During the past several years, Ford began to experiment with oxygen-fuel lances through which both the fuel and oxygen are introduced to produce extremely high temperatures.

These developments led to consideration of how the entire process might be hastened even more with the extra heat available. A critical consideration is that if the molten iron is added too quickly, the entire mass freezes, retarding the process. It was reasoned that if burned lime were used instead of limestone, it together with the oxygen should make even more heat available and hurry the process along without the risk of the mass freezing in the furnace.

This idea was tried. The 200-ton furnace was charged with burned lime and scrap with the oxygen fuel lance in operation. As soon as the initial charging process was completed, the molten iron was added. This was done about one-half hour after the start, rather than two or more hours later. The fuel in the oxygen-fuel lances was shut off allowing the conventional end-firing burners, the heat-producing chemical reaction of the ingredients and the continuous flow of oxygen to refine the steel.

In less than three hours, 200 tons of steel were tapped—steel of outstanding quality.

In this and subsequent experiments, the furnace has averaged more than 60 tons an hour, compared with 30 tons per hour previously.

Ford has tried the new process in a 400-ton open hearth furnace equipped with the oxygen-fuel lances. Although fewer heats have been tried in this furnace than in the smaller one, the new process has been yielding approximately 100 tons per hour, compared with 40 tons per hour using normal oxygen practices and 30 tons per hour before any of these recent techniques were developed.

With these results, it is believed the process is a significant forward step in making open hearth steel.

Production of steel by the new method will be restricted until Ford has completed new oxygen-producing facilities.

The Ford Steel Division last year embarked on a modernization and quality improvement program which will cost an estimated $35,000,000 in three years. This program was partly responsible for the experiment that led to development of the new process. Even if future experiments confirm the promise of the new process, Ford plans to buy the greater portion of its steel requirements from outside suppliers, as it has in the past.

Ford Motor Co. now is the 13th largest steel producer in the United States. The company began making steel in 1923 and its 1960 annual ingot capacity is listed as 1,940,000 tons.

* * * * *

Editor's Note—The oxy-fuel lance was developed by Air Products, Inc. for application in the open hearth furnace, as part of its applied research and development program. The oxy-fuel lance mixes and burns natural gas with oxygen. Different fuel-oxygen ratios can be achieved as required during a heat in the open hearth furnace. Flame temperatures of up to 6,000 F are obtained.

Oxy-fuel lances, with two lances per furnace are in use at Ford. Each lance handles 50,000,000 Btu's per hr of natural gas in approximately a two to one ratio of oxygen to natural gas.

Currently, oxy-fuel lances which will handle 60,000,000 Btu's per hour of natural gas and 100,000,000 Btu's per hr are being constructed for other companies. ▲

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Revolutionary is the word for the plus features on Automatic's unique Elbolift! This compact, stand-up end control design permits tight maneuvering in congested areas ...stacks up to 120" high...features improved load distribution...has new ease of operation with forward and reverse speeds plus lift and tilt controlled by one lever... and inching is controlled through a foot operated pedal.

Available in two power packages, too! Conventional battery-powered models (pictured), in capacities from 12,000 through 25,000 lbs; or the sensational gas-operated electric-drive models available in capacities from 15,000 through 20,000 lbs. Can also be equipped for LPG fuel.

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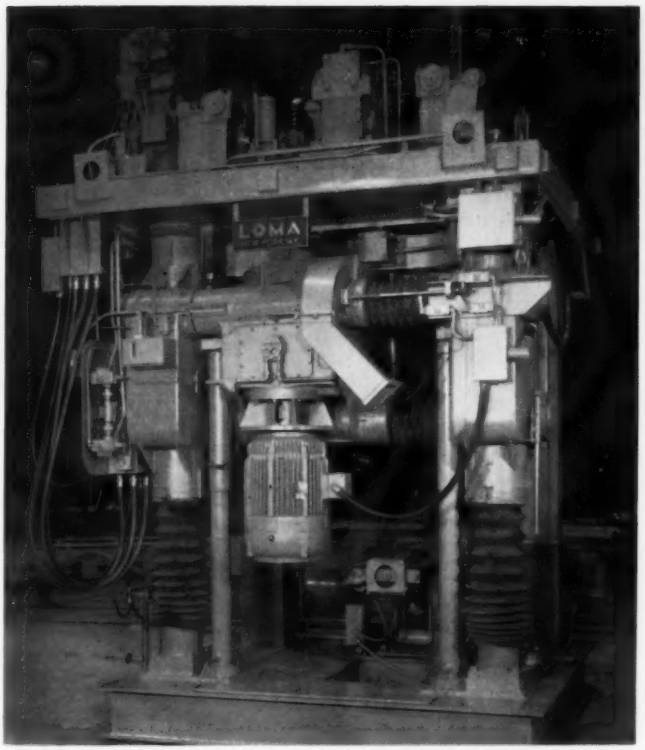

Figure 1 — Continuous casting machine can produce billets and slabs.

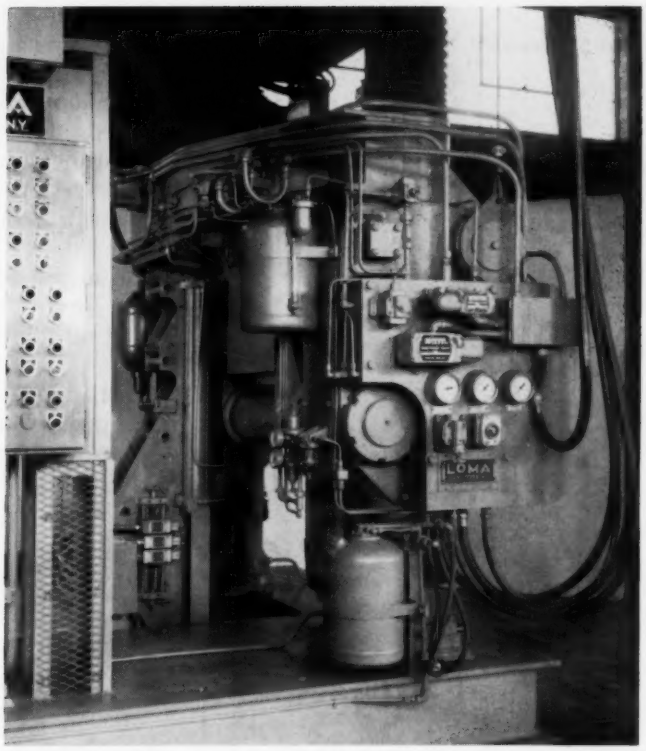

Figure 2 — Operator's control station has electrical and hydraulic machine controls.

New Continuous Casting Machine for Copper Has Improved Features

ONE of the most significant advances in copper billet and slab casting technique, announced by Loma Machine Manufacturing Co., Inc., of New York, is a productive and versatile fully continuous casting machine. The equipment handles copper in all its various forms—from phosphor, de-oxidized and oxygen-free, to fire refined and tough pitch. The basic design of the machine also lends itself to the casting of brasses, bronzes, aluminum and magnesium alloys. The shapes produced on the unit include round piercing and extrusion billets, square wire bars and rectangular slabs. The production capacity of the machine ranges from 3 tons per hour for double-strand casting of 3-in. diam billets to 10 tons per hour for single-strand casting of 5½ x 33-in. slabs.

The continuous casting machine is usually fed with liquid metal from either an arc or induction melting furnace followed by an induction holding furnace. The molten copper at a temperature of 2150 F then flows through a special refractory-lined distributor equipped with down spouts extending into the molds. The rate of flow of the metal through the down spouts extending below the metal surface is controlled by the operator with needle valves. This "underpouring" method assures a smooth, splash-free entry of clean metal into the mold cavity, thus eliminating internal porosity and inclusions in the cast material.

The billet, bar and slab molds are of copper construction and are mounted at the top of the casting machine. The mold water jackets feature a special internal baffle design which greatly enhances their heat removal capacity. The cooling water initially flows through the mold jackets and then emerges from an adjustable slot at the mold bottom to impinge on the solidified metal surface in direct spray form. The spray water is collected in a water box mounted below the molds and is recirculated.

To prevent sticking of the cast copper to the mold and to assure a smooth metal surface, the entire mold assembly is oscillated by a reciprocating gear. The vertical stroke is only a fraction of an inch, and the rate of vibration can be adjusted up to several hundred cycles per minute by means of a variable speed drive.

The solidified metal strands are continuously withdrawn from the molds by a double set of 9-in. diam pinch rolls made of stainless steel. Proper clamping pressure is applied to the pinch rolls by opposed hydraulic cylinders and, in addition, spring pressure is provided to hold the stock firmly in cases of power failure. The pinch rolls are driven through reduction gearing by a 5-hp, d-c motor to obtain infinitely variable casting speeds up to 60 in. per min.

Immediately below the withdrawing rolls and mounted on a traveling carriage is the flying circular cutoff saw. The saw employs a 36-in. diam high speed steel segmental blade driven by a 40-hp motor at 1200 fpm. The cutting feed rate is adjustable up to 2 in. per sec, while the return rate is 4 in. per sec. The entire cycle of clamping, carriage descent, saw advance, saw return and carriage return is performed automatically.

The cut billets or slabs are received in the discharge basket which is tilted automatically by a pneumatic cylinder through 90 de-

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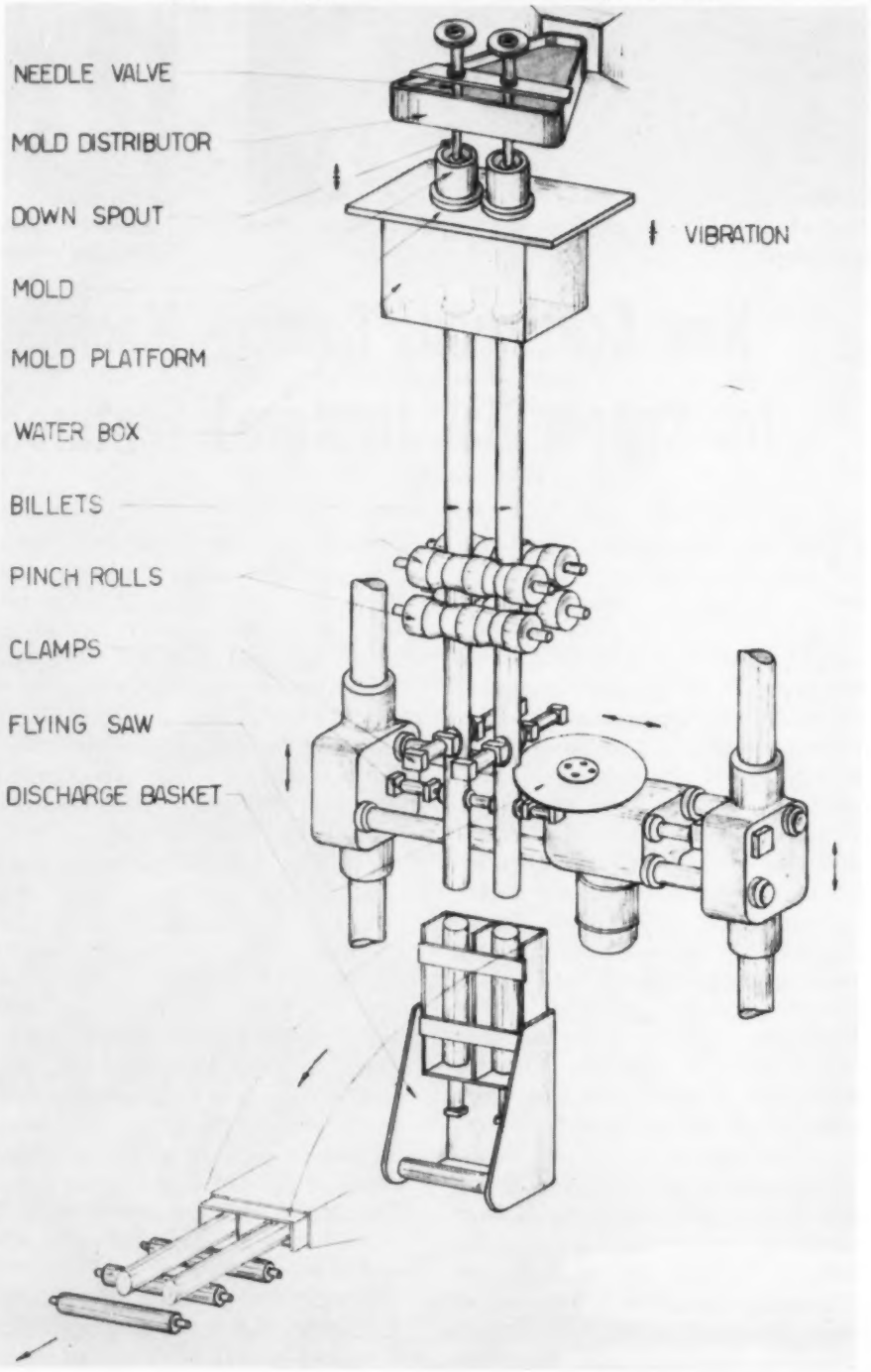
grees. Once the basket reaches its horizontal position, the castings are ejected onto a roller conveyor by air cylinder action. Finally, an air-operated stamping device applies an identification mark to one end of each casting. The product is then removed to stockpile or immediate use.

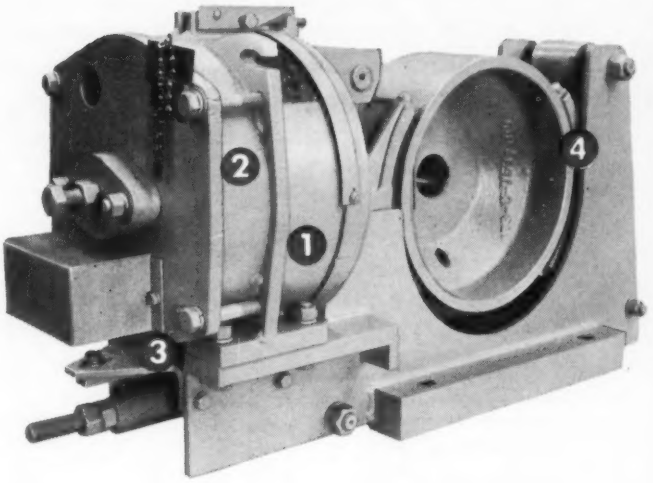
The major advantages to be obtained from the new continuous casting machine are:

1. Machine mechanization requiring only one operator improves plant productivity.
2. Steady casting conditions give uniform, dense ingot structure from end to end.
3. Smooth metal pouring eliminates turbulence and entrapped oxides, dross and gasses.
4. Rapid cooling produces a fine-grained, sound structure even in large cross sections.
5. Predominantly longitudinal solidification prevents piping and internal stresses.
6. Long casting length and absence of cropping losses improve yield.
7. Simple, short molds reduce cost of and space required by casting shop inventory. ▲

Figure 3 — Diagram of continuous casting machine.



MILL-DUTY ACCESSORIES



DC BRAKES

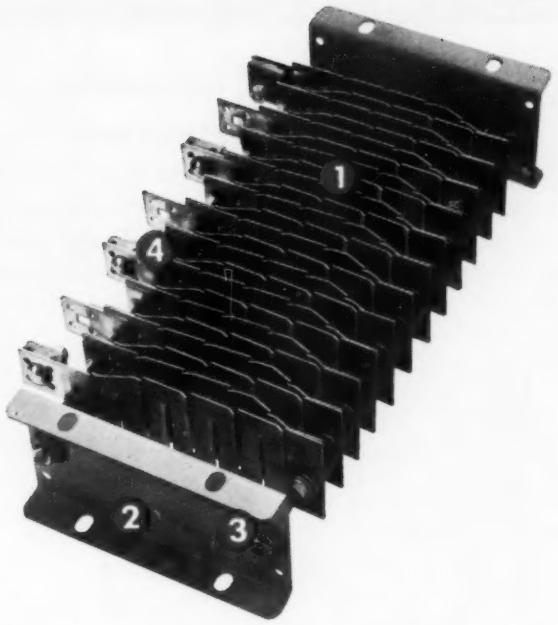
Single-end adjustment speeds maintenance and installation

New General Electric d-c brakes—featuring single-end shoe adjustment—are designed for easy maintenance and versatile installation. And, compensation for lining wear requires simple adjustment from only one end of the brake!

Here are more new features which make General Electric d-c magnet brakes your best buy for dependable, low-maintenance service:

1. **New magnet housing design** permits vertical removal, easy interchange.
2. **New coil** features all high temp. insulating materials potted in epoxy making brake ideal for the most rugged jobs.
3. **New pivot arm** assures equal shoe braking pressure.
4. **Easy lining replacement** does not require removal of brake shoe assembly . . . just lining.

Want details? See your G-E Apparatus Sales Engineer. Or, write Sect. 784-27, General Electric Co., Schenectady, N. Y., for Bulletin GEA-7067. *Industry Control Dept., Salem, Virginia.*



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1. **Unique grid paralleling** saves time and expense since all parallel connections are made at factory. Grids come either series or parallel.
2. **Draw-out construction** speeds mounting in frame, assures positive alignment. Boxes are readily removed without disturbing those in place.
3. **Clip-lock and carriage-bolt fastener**—special device on runner guides locks box securely in frame. Front is bolted with only 2 self-holding bolts.
4. **All-purpose terminals** accommodate bus or cables. Taps provide means for adjusting resistance values.

Like to know more? Contact your G-E Apparatus Sales Engineer, or write Sect. 784-27, General Electric Co., Schenectady, N. Y., for GEA-6858. *Industry Control Dept., Salem, Va.*

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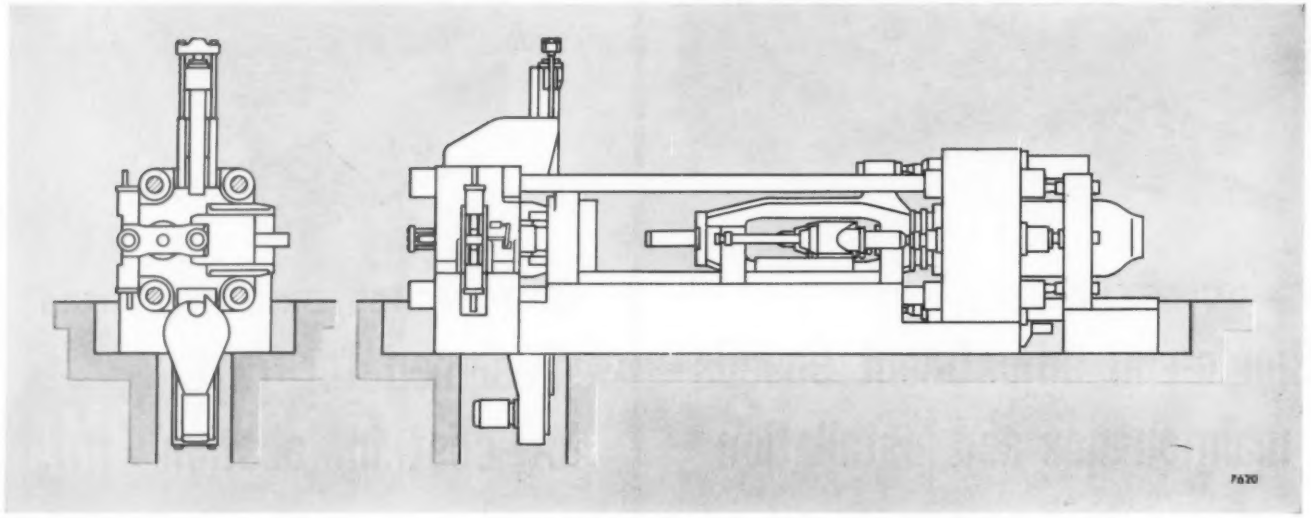


Horizontal extrusion press for non-ferrous metals with rotary die head and internally-arranged piercer.

Features and advantages

- Good accessibility to the press and tools through effective arrangement of the columns, tie-bars and guideways, and through a long-stroke container shifting device.
- Simple and quick tool changing through a rotary die head, die changer and quick-action locking arrangements.
- Speedy removal of the extrusions by severing behind the die. (Axial displacement of the die).
- Compact design of the press and efficient mandrel guidance through an internally-arranged mandrel manipulator or piercer with mandrel stroke adjuster, mandrel stroke limiter, relative stroke mechanism and mandrel turner.
- Improved quality of extrusions and longer tool life through the incorporation of cooling arrangements for the billet container, die and mandrel.

Inspecting a 2750-ton extrusion press of the four-column type, with rotary die head, demonstrated under workshop conditions on the occasion of the SCHLOEMANN Congress held at the MAN plant at Nuremberg.

FELLER ENGINEERING COMPANY 1161 Empire Building, Pittsburgh 22, Pa.

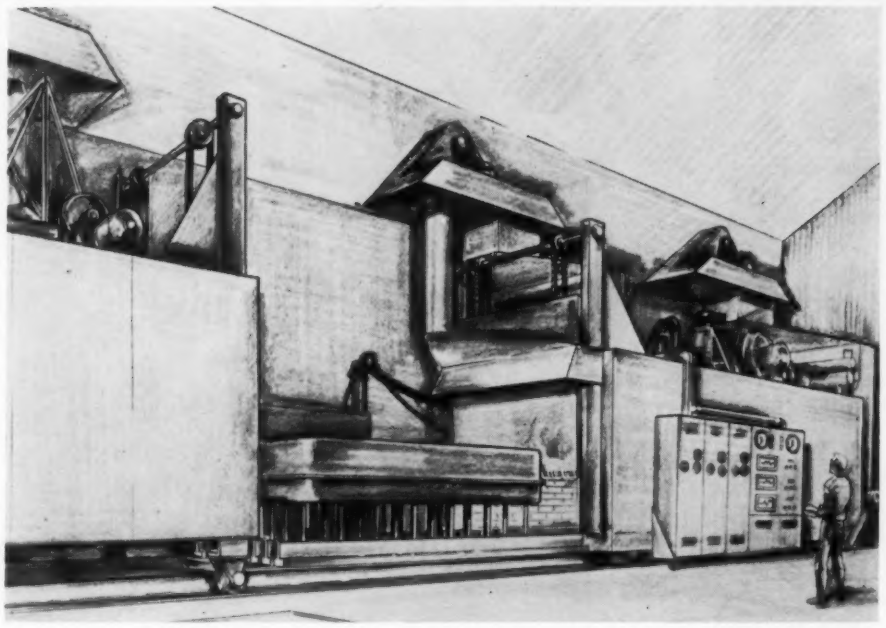


Figure 1 — Artist's conception of completed furnace.

Silica Refractory in Furnaces Reduces Production Costs

BY using a unique cellular silica material to insulate their new atmospheric brazing furnace, Pacific Scientific Co. of Los Angeles, Calif., were able to save 80 per cent of the estimated heating costs. Thus, since they were able to eliminate four-fifths of the usual firing equipment, production costs were cut by $80,000.

The furnace was designed for a large aircraft subcontractor to be used in the manufacture of honeycomb aircraft and missile parts. Honeycomb sections up to 12 ft wide by 20 ft long by 4 ft in height can be handled in the furnace.

Key to the furnace's performance is a new, lightweight refractory, Foamsil, a product of the Pittsburgh Corning Corp. The material is 99 per cent pure fused silica glass foamed in a special, very high temperature furnace to create millions of tiny sealed cells. The material can cycle from −450 F to +2000 F without thermal shock. It weighs only 13 lb per cu ft, yet has a compressive strength of 200 psi.

However, the key factor is the material's low specific heat—only 0.277 at 1200 F—combined with light weight.

To get dependable brazed joints in aircraft alloys on a production basis and with a minimum of rejects, the brazing furnace must provide accurately controlled heating and cooling cycles; in many cases, allow components to be handled in the protective atmosphere of a retort; and must provide facilities for fast loading and unloading.

In designing the production brazing furnace, three honeycomb brazing problems had to be overcome: (1) the material had to be held very straight; (2) it must be heated to the desired temperature very rapidly; and (3) the heat must be taken out of it quickly to enable the braze to set.

The first problem was overcome by the design of a portable furnace which would move over the part to be brazed as it rests on upright rods and then backs away from it after the brazing operation.

Foamsil took care of the other two problems because of its low residual heat capacity, light weight and low heat storage capacity.

The furnace is designed to operate at a temperature of approximately 2000 F. Over-all dimensions are 91 by 21 ft. Forty-six gas burners supply the needed heat. A total of 3000 board feet of Foamsil was installed in the furnace. A double row of 17 by 22-in. blocks were installed; one layer 2-in. thick and another 3-in. thick. Special cement was used as the adhesive. A 4-in. layer of another insulating material was used as backup.

Total weight of the furnace is 75,000 lb and the hearth alone weights 25,000 lb. Total cost is $163,000. Of this figure, $20,000 is for heating equipment.

Apart from fuel and equipment savings, the large, but light, cellular silica blocks enabled speedier installation with accompanying savings in labor costs. ▲

Figure 2 — Interior of heating chamber has heating forks installed.

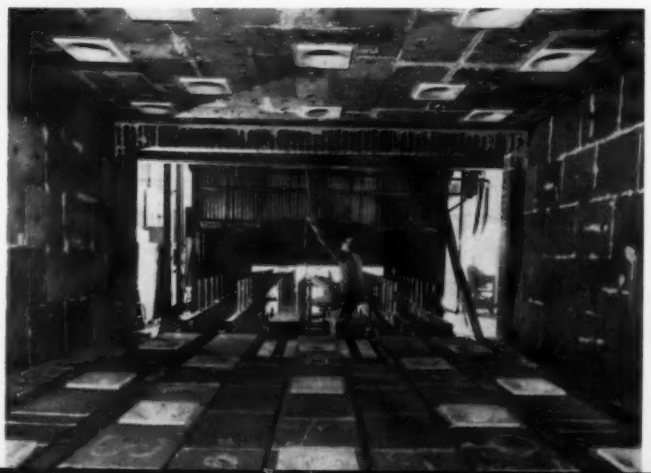


Figure 3 — Refractory is easily cut.

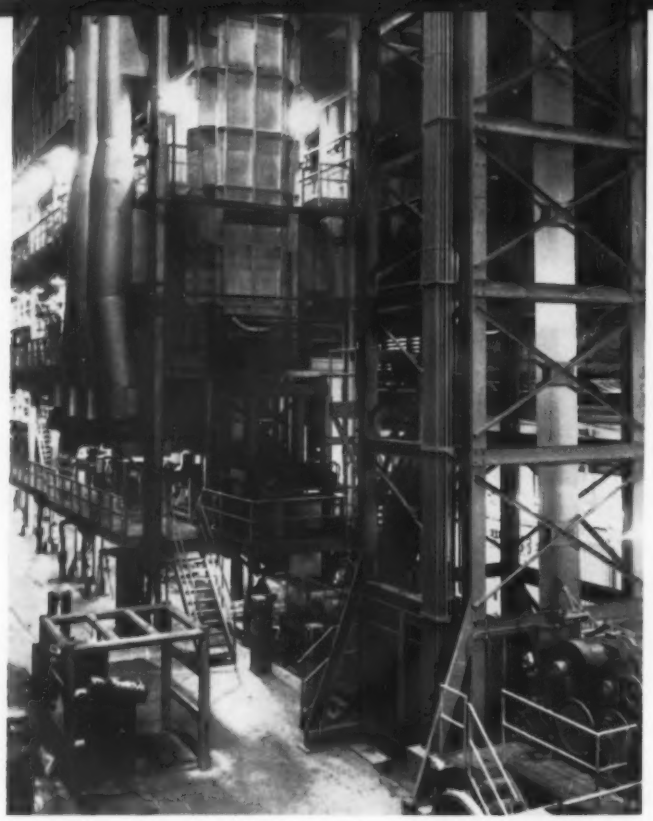


Figure 1 — One of the fastest and most modern continuous annealing lines in the steel industry has gone into operation at the Aliquippa, Pa., works of Jones & Laughlin Steel Corp.

J & L Starts New Annealing Line At Aliquippa Works

A NEW continuous annealing line—one of the fastest and most modern in the steel industry—has gone into operation at the Aliquippa Works of Jones & Laughlin Steel Corp. for the production of tinplate.

The new high-speed line, which is designed to operate at speeds up to 2000 fpm, represents another step in J&L's continuing program to help the can industry meet the needs for an even higher quality tin can.

In J&L's continuous annealing line, a single strand of strip steel is exposed to closely controlled heating conditions. Variations in hardness are minimized. The relatively short time at the higher heat and "soak zone" temperatures produce a fine grain structure in the steel that is more uniform throughout. This precise annealing relieves internal strains created in the steel by an earlier cold rolling process.

At a speed of 1000 fpm on the new line, the strip is heated at 1350 F for 22 sec, soaked for 29 sec at the same temperature, cooled in 22 sec to 900 F and finally cooled to 150 F in 43 sec.

The line can handle coils of strip steel weighing up to 50,000 lb, up to 85 in. in outside diameter, and in widths from 18 through 38½ in.

J&L is installing an electronic computer on the new line to be used initially as a data accumulation system. Sensing devices will record strip gage, temperature, speed and other factors. Ultimately, the computer will regulate temperature and speed variables on the line.

J&L's new line is the first of its type designed with coordinated mechanical and electrical drives throughout the equipment. The improvement minimizes variations in tension throughout the line during acceleration and deceleration, provides greater product uniformity and permits maximum utilization of equipment.

Another feature on the new line is a thickness gage on the entry end. This gage, which indicates any irregularities in thickness of a coil of strip, permits discarding any off-gage material at the head and tail ends of the coil before the strip enters the annealing line furnace.

The line also is equipped with a shifting system on the pay-off reel and on the winding reel. This keeps the strip centered in the line, thereby eliminating damage to strip edges during the annealing operation.

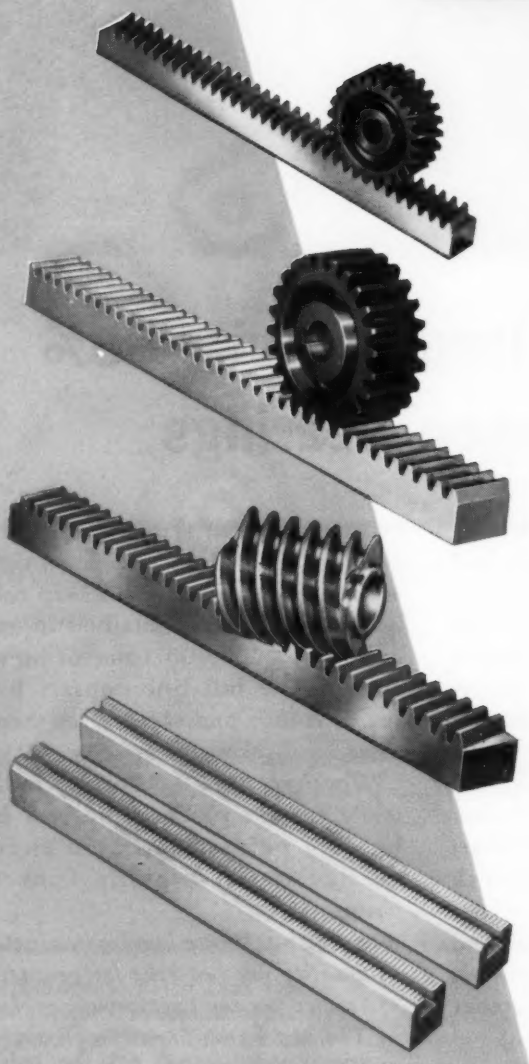
The seam welder, which is used to weld coils into a continuous strip, has been equipped with a regulatory system permitting control over each weld wheel and compensating for any difference in welding condition between wheels. The welding unit also has a motor clutch permitting a welding speed range from 24 to 72 fpm to cover any variance in strip thickness.

The line's looping tower, which can provide storage for approximately 1250 ft of strip to prevent delays caused by welding coils, also has been equipped with an air-cylinder strip brake mechanism. This mechanism is designed to bear down on top of the rolls to prevent unthreading of the line in case of strip breakage.

The annealing furnace is divided into four sections—heating, soaking, controlled cooling and final cooling—for a total length of 1960 ft. It is heated by 105 recuperative-type burners, each of which has a maximum gross input rating of 400,000 Btu per hr.

A new technique was employed in the construction of electrical equipment for the line. This equipment was preassembled and pretested and delivered as a package to the construction site. This minimized installation and testing time on the new line. ▲

GEAR RACKS



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Throughout industry, manufacturers depend on ILLINOIS GEAR to meet their exacting specifications for quality gear racks . . . from the large powerful, heavy pitch racks for steel mill equipment to the precision spur or helical racks for machine tools.

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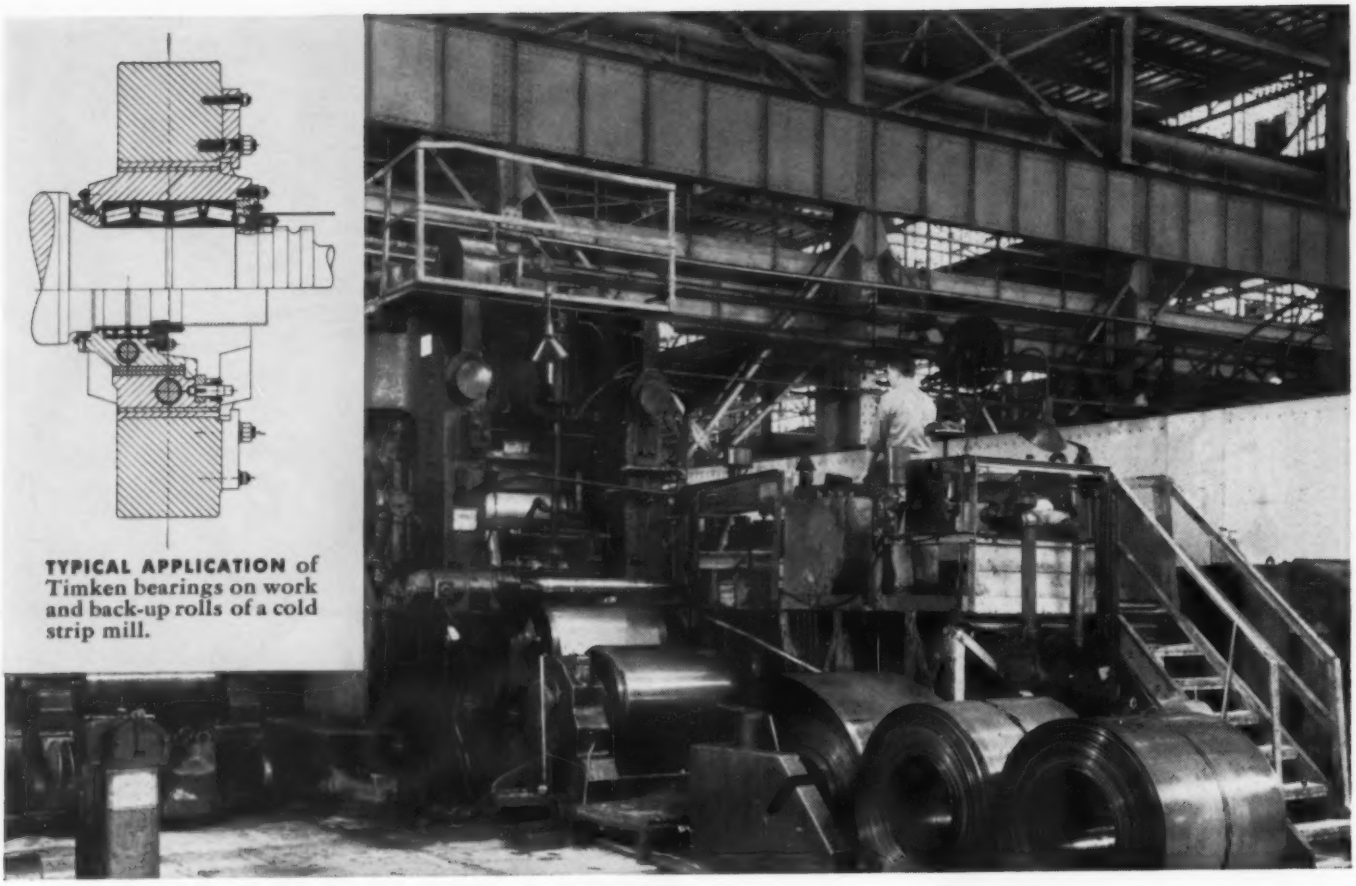


TYPICAL APPLICATION of Timken bearings on work and back-up rolls of a cold strip mill.

Inland Steel boosts bearing load capacity 50% —just by switching to Timken® bearings

BY switching to Timken® bearings on the roll necks, Inland Steel obtained a 50% gain in load capacity with no increase in power demand on the 4-high cold reversing mill above. Longer bearing life resulted, too. What's more they gained these advantages without sacrifice of compact design. With previous bearing designs, momentary overloads caused premature failures. And low permissible screw down pressures limited rolling practice.

Timken roll neck bearings are used in over 1,000 mill installations around the world to assure minimum cost per ton of steel rolled. That's because: 1) *They roll the load*—virtually eliminate friction. Timken bearings have tapered design to take both radial and thrust loads. 2) *They are precision manufactured*—assuring close control of product gauge. 3) *They minimize maintenance;* Modern Timken roll neck bearings are designed to provide the best combination of bearing capacity, rigidity and roll neck strength for a given mill roll diameter. Bearings and roll necks stand up longer under load. Grease or oil mist lubrication provides further economies. And, 4) *they give longer bearing life.* Mill records show that service life of Timken back-up roll bearings has been obtained in excess of 12,000,000 tons of steel rolled. The full-line contact between rollers and races gives them extra load-carrying capacity.

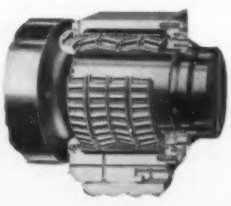
When you buy or build a mill, make certain you buy the best in bearing performance and engineering service—specify Timken bearings.

When you buy Timken bearings you get...
1) Quality you can take for granted.
2) Service you can't get anywhere else.
3) The best-known name in bearings.
4) The pace setter in lower bearing costs. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.* Canadian Division: Canadian Timken, St. Thomas, Ontario.

Industry rolls on

TIMKEN®

tapered roller bearings



SUTTON-MAUST
double-tilt Roller Levelers

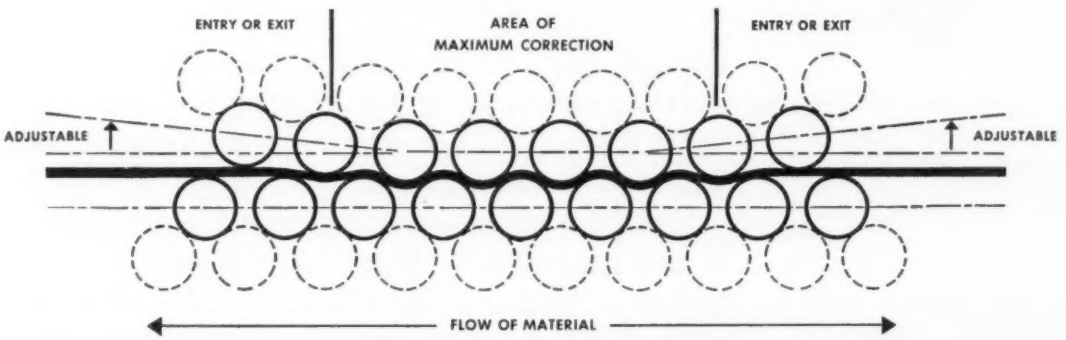
For sheets, plate and strip
including tension leveling of coil stock

- Better flatness and shape correction in all modern metals.
- Easier feeding, no pinch rolls are required, entry marks are eliminated.
- Roll design is symmetrical, work flow is reversible without adjustment.

Sutton-Maust double-tilt, backed-up roller levelers provide the finest precision flattening and correcting of ferrous and non-ferrous sheets and strip. Accuracy obtained, easily meets or betters the most critical expectations.

All sizes are available for all modern metals of any required width and in gauges from .001″ to .750″. They may be used for both sheets and coils in process lines, cut-to-length lines and tension leveling lines. Motorized adjustments permit remote control in processing lines.

DOUBLE TILT DESIGN



Sutton-Maust Roller Levelers are manufactured by Maust Machinery Corporation, Queens Village 27, N. Y. Maust patented, double-tilt design provides highest accuracy of flatness available.

In the exclusive double-tilt design, the top work rolls are arranged in a symmetrical pattern with the entry and exit rolls tilting slightly upward. The entry rolls subject material to gradually increasing waves, the centrally located roll group produces a series of uniformly deep waves for maximum correcting work and the exit group completes the flattening process perfectly.

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Date-line Diary...

May 2

Δ National Machine Tool Builders' Assn. reports net new orders for March, 1960, totaled $61,000,000, shipments amounted to $64,250,000 compared with net new orders in February, 1960, totaling $60,600,000 and shipments of $51,950,000. For the first quarter of 1960 net new orders totaled $178,050,000, shipments $162,600,000.

Δ The Bureau of the Census reports that shipments of copper-base mill and foundry products for the year 1959 totaled 4,819,000,000 lb, an increase of 19 per cent over 1958 total shipments.

Δ The AISI reports that the operating rate of the steel industry for the week of May 2 is scheduled at 2,132,000 tons (74.8 per cent of capacity). This compares with 2,210,000 tons one week ago (77.6 per cent capacity) and 2,604,000 tons one year ago. Index of production for the week is 132.7.

Δ Auto assemblies in April, 1960, amounted to 582,848 cars, compared with 654,252 cars in March, 1960, and 578,848 cars in April, 1959. Sales in April, 1960, totaled 579,000.

May 3

Δ Steel scrap prices in Pittsburgh dropped $1 a ton to about $34 a ton for No. 1 heavy melting.

Δ American Iron Ore Assn. reports that shipments of iron ore down the Great Lakes in April, 1960, totaled 5,645,840 gross tons, compared with 2,978,023 gross tons in April, 1959.

Δ The joint report by American Iron Ore Assn. and AISI shows that receipts of iron ore and ore agglomerates in the U. S. in March, 1960, totaled 4,299,285 gross tons compared with 3,542,992 tons in March, 1959. Consumption in the U. S. in 1960 to March 31, totaled 34,981,518 gross tons compared with 31,050,600 gross tons in 1959. On March 31, 1960, in the U. S. blast furnaces in operation totaled 223 of the existing 258, compared with 224 in operation as of March 31, 1959.

May 4

Δ Caland Ore Co., Ltd., subsidiary of Inland Steel Co., plans to spend $66,000,000 developing a mining operation near Atikokan, Ontario.

Δ Bureau of the Census reports that shipments of iron and steel castings for the month of February, 1960, totaled 1,320,098 short tons compared with 1,341,328 tons in January, 1960, and 1,220,551 tons in February, 1959.

May 5

Δ The Commerce Dept. reported that U. S. imports in March, 1960, rose above $1,300,000,000, up $67,000,000 over February, 1960, and $60,000,000 over March, 1959. Exports for March, 1960, totaled $1,600,000,000, an increase of $137,000,000 over February, 1960, and $260,000,000 over March, 1959.

Δ The Bureau of the Census reports that new construction put-in-place in April, 1960, amounted to $4,009,000,000 compared with $3,696,000,000 in March, 1960, and $4,284,000,000 in April, 1959.

Δ The AISI reports that the steel industry's employment of hourly and salaried workers in March, 1960, totaled 637,328 compared with 642,506 in February, 1960, and 603,635 in March, 1959. The payroll for hourly and salaried workers combined for March, 1960, totaled $398,847,573, against $381,387,774 in February, 1960, and $385,413,953 in March, 1959. Hourly rate in March was $3.343 compared with $3.372 in February, 1960, and $3.336 in March, 1959, excluding estimated employee fringe benefits costing 45¢ an hour on the average during 1960. Average hours per week in March, 1960, were 40.2, compared with 40.0 in February, 1960, and 41.0 in March, 1959.

Δ The Bureau of Mines reported that the production of Pennsylvania anthracite for April, 1960, was 1,231,000 net tons compared with 1,680,000 tons in March, 1960, and 1,503,000 tons in April, 1959.

May 6

Δ The AISI reported that shipments of finished steel products in March, 1960, amounted to 7,965,881 net tons, against nearly 7,600,000 tons in February, 1960, and 8,100,000 tons in March, 1959. For the first quarter of 1960 shipments totaled 23,966,967 net tons against 20,800,000 tons during the first quarter of 1959.

Δ The AISI and American Iron Ore Assn. joint reports show that receipts of iron ore and ore agglomerates in the U. S. for the first quarter of 1960 amounted to 13,374,056 gross tons compared with 9,741,203 tons in the first quarter of 1959.

May 9

Δ Canadian steel ingot production in April, 1960, totaled 506,577 tons compared with 480,805 tons in April, 1959; pig iron output in April, 1960, amounted to 395,615 tons compared with 366,838 tons in April, 1959.

Δ The AISI reports that the operating rate of the steel industry for the week of May 9 is scheduled at 2,102,000 tons (73.8 per cent of capacity). This compares with 2,137,000 tons one week ago (75.0 per cent capacity), and 2,631,000 tons one year ago. Index of production for the week is 130.9.

May 10

Δ The Aluminum Assn. reports that net shipments of aluminum sheet and plate for March, 1960, totaled 121,226,000 lb, compared with 109,135,000 lb in February, 1960. Shipments of aluminum foil in March, 1960, totaled 20,436,754 lb, compared with 19,082,907 lb in February, 1960.

May 11

Δ The Commerce Dept. reported that retail sales in April, 1960, rose to a seasonally adjusted $18,900,000,000, three per cent over the March, 1960, figure.

Δ The AISI reported that steelmaking furnaces in the U. S. in April, 1960, poured 9,771,000 net tons of ingots and steel for castings, compared with 11,564,683 tons in March, 1960, and 11,281,920 tons in April, 1959.

May 12

Δ Government figures showed that employment in mid-April soared to 66,159,000; unemployment dropped to 3,660,000 down 546,000 from mid-March level.

Δ Commerce Dept. reported that the gross national product in the first quarter of 1960 reached a seasonally-adjusted rate of $500,200,000,000 annually.

May 16

Δ Spot copper in London, last week, declined ½¢ to 30¾¢ a lb.

Δ The AISI reports that the operating rate of the steel industry for the week of May 16, is scheduled at 2,042,000 tons (71.7 per cent of capacity). This compares with 2,102,000 tons one week ago (73.8 per cent capacity) and 2,644,000 tons one year ago. Index of production for the week is 127.1.

May 18

Δ The Commerce Dept. reported that personal income in April rose to a seasonally adjusted rate of $397,400,000,000, which was $3,400,000,000 above the March, 1960, rate and $18,400,000,000 above the April, 1959, pace.

Δ Detroit Steel has extended to June 13 its offer to shareholders of Portsmouth Corp. to exchange 1.55 shares of Detroit Steel Corp. common shares for each share of Portsmouth stock.

Δ Bureau of the Census reports that shipments of commercial steel forgings in March, 1960, totaled 137,906 short tons compared with 129,799 tons in February, 1960, and 128,816 tons in March, 1959. Unfilled orders at end of month totaled for March, 1960, 356,248 short tons, compared with 398,256 tons in February, 1960, and 396,112 tons in March, 1959.

Δ The ARCI reports that deliveries of new freight cars in April, 1960, totaled 5579, compared with 5950 in March, 1960, and 3741 in April, 1959. Orders in April, 1960, totaled 5551 compared with 1959 in March, 1960, and 3736 in April, 1959. Backlog of cars on order as of May 1, 1960, totaled 41,003, compared with 42,131 cars on April 1, 1960, and 35,497 on May 1, 1959.

May 20

Δ Lukens Steel Co. report for the 12 weeks ended March 26, 1960, net sales amounting to $30,416,889, net income of $2,314,442 or $2.43 per share; compared with the 12 weeks ended March 28, 1959, sales amounting to $20,449,381, net income of $1,008,394 or $1.06 per share.

Δ Northwestern Steel and Wire Co. reports for the quarter ending April 30, 1960, net sales amounting to $21,817,177, net income totaling $2,370,863 or $0.95 per share, compared with the same period of 1959, net sales totaling $25,173,642, net income of $2,670,882 or $1.07 per share. For the nine months ended April 30, 1960, sales totaled $45,935,269, net income amounted to $3,493,647 or $1.40 per share, compared for the same period of 1959 sales totaling $59,809,970, income of $5,631,008 or $2.25 per share.

Δ The U. S. Dept. of the Interior, Bureau of Mines reports that consumption of scrap in March, 1960, amounted to 6,661,000 tons, compared with 6,493,558 tons in February, 1960; consumption of pig iron in March, 1960, totaled 6,875,000 tons compared with 6,601,704 tons in February, 1960.

Δ The Japan Iron & Steel Federation reports that production of pig iron in Japan in March, 1960, amounted to 10,100,000 net tons, production of crude steel totaled 1,975,000 net tons.

Δ The Bureau of the Census reported that production of titanium mill products in March, 1960, totaled 645,276 lb, compared with 497,701 lb in February, 1960, and 644,152 lb in March, 1959.

May 23

Δ The AISI reports that the operating rate of the steel industry for the week of May 23 is scheduled at 1,906,000 tons (66.9 per cent of capacity). This compares with 2,031,000 tons one week ago (71.3 per cent capacity) and 2,650,000 tons one year ago. Index of production for the week is 118.7.

Δ The Bureau of the Census reports that net shipments of aluminum pig and ingot in March, 1960, totaled 166,017,000 lb, compared with 170,407,000 lb in February, 1960, and 114,576,000 lb in March, 1959. Net shipments of aluminum mill products for March, 1960, totaled 266,772,000 lb, compared with 256,017,000 lb in February, 1960, and 272,867,000 lb in March, 1959.

Δ Reading Tube Corp. announced plans to merge into Progress Manufacturing Co. Inc., Philadelphia. Terms include an exchange of stock at the ratio of one share of Reading Tube common for 6/10 share of Progress common.

May 24

Δ The Aluminum Assn. reports that primary aluminum production in the U. S. in April, 1960, amounted to 168,596 short tons compared with 170,688 tons in March, 1960, and 155,213 tons in April, 1959.

May 25

Δ Treasury-Secretary Anderson urged legislators to extend for another year beyond June 30, the present 52 per cent corporate tax rate and the Korean wartime excise levies on liquor, tobacco and autos.

Δ The AISC reported that bookings of fabricated structural steel for April, 1960, amounted to 344,944 tons compared with 342,859 tons in March, 1960, and 294,806 tons in April, 1959. Shipments in April, 1960, totaled 286,884 tons, compared with 276,977 tons in March, 1960, and 290,623 tons in April, 1959. Backlog as of April 30, 1960, amounted to 2,401,225 tons.

Δ Resistance Welders Manufacturers' Assn. reported that shipments of resistance welding equipment during April, 1960, amounted to nearly $3,000,000, slightly less than March, 1960, shipments. Backlog at the end of April was reported at almost $12,000,000.

May 26

Δ The National Machine Tool Builders' Assn. reports that shipments of metal-cutting and metal-forming type machine tools in April, 1960, totaled $55,350,000; net new orders in this period totaled $51,650,000. This compares with shipments amounting to $64,500,000, and net new orders totaling $62,040,000 in March, 1960.

Δ The tax-writing House Ways and Means Committee approved a bill setting the temporary Federal debt ceiling at $293,000,000,000, and extending present corporate and excise tax rates another year.

May 31

Δ The Commerce Dept. reported that construction outlays in May, 1960, held at the seasonally adjusted annual rate of $53,900,000,000. For the first five months of 1960 building expenditures were two per cent under the like period in 1959.

Δ The AISI reports that the operating rate of the steel industry for the week of May 30 is scheduled at 1,765,000 tons (61.9 per cent of capacity). This compares with 1,870,000 tons one week ago (65.6 per cent capacity) and 2,653,000 tons one year ago. Index of production for the week is 109.9.

Δ The Supreme Court ruled the Federal Government owns the oil-rich submerged lands beyond the 3½-mile limit off the coast of Mississippi, Alabama and Louisiana; however, Texas and Florida were granted control of the so-called "tidelands" all the way out to the 10½-mile limit. The decision gives the three grantees $308,000,000 in royalties from oil and gas companies, plus the right of future royalties.

Δ Aluminum Co. of America started operating one potline at its new Warrick, Ind., reduction plant.

Another example of National Roll quality control

Jack Russell, National's foundry superintendent, discusses an electric furnace heat with Bill Mason of the sales department.

Your steel rolls are custom-melted

National's electric furnace facilities for steel roll production are among the most modern in the industry. Furnace sizes, molding facilities, annealing equipment; all have been selected to provide the close metallurgical control needed at every step to produce high quality rolls that give long tonnage life.

This custom service extends to every roll order produced by National, whether steel, nodular iron, or iron. Since rolls are our only business, every phase of our operations is staffed with men who know *their* business, and how it affects *yours.*

We'd like to have you meet some of these men. The best way is to plan a visit to our modern plant at Avonmore. But if time prohibits this, let us send you a brochure that will tell you more about why . . .

National's the growing name in rolls

NATIONAL ROLL & FOUNDRY DIVISION

GENERAL STEEL CASTINGS CORPORATION, Avonmore (Westmoreland County), Pa.

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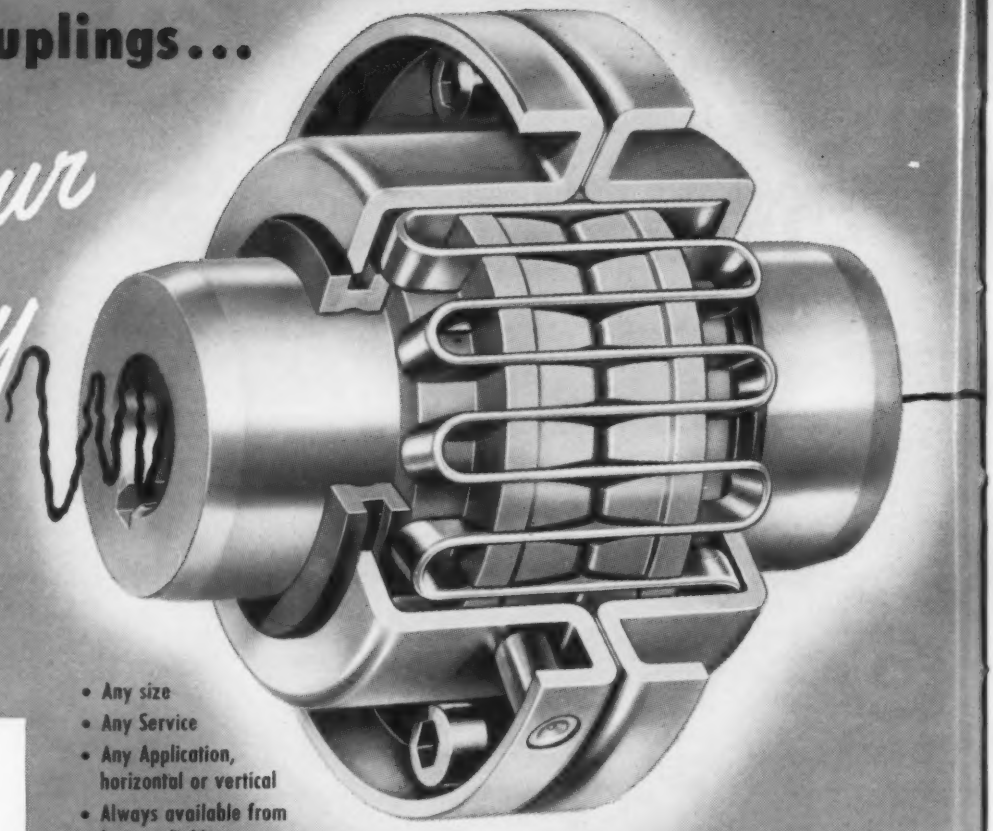
Falk Steelflex Couplings...

Protect your machinery in 2 ways



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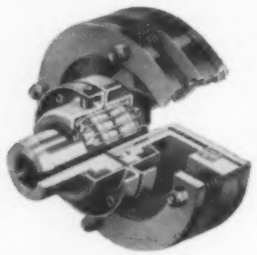

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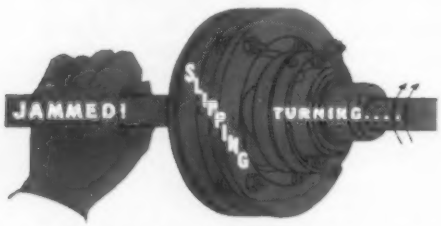
Falk Controlled Torque Couplings prevent damage from overloads

In applications where danger from overloads exists, use the FALK Type FT Controlled Torque Coupling. The Type FT has all the features and advantages of standard FALK Steelflex couplings—and, in addition, has an adjustable friction slip clutch, enabling the operator to set the coupling to slip at any predetermined overload.

This controlled-torque principle not only prevents transmission of dangerous shocks and limits overloads; it eliminates the breaking of shafts caused by jamming of driven equipment.

An outstanding advantage of the Type FT Coupling is that, as soon as the cause of the overload is removed, the entire coupling will rotate and transmit power without replacing parts or repairing coupling.



There's real economy in using Type FT Controlled Torque Couplings. Many users have reported that these couplings paid for themselves the very first time they slipped (under overload) because of the protection against damaged driving or driven machinery!

...cost less per year of service!

You get *double protection* when you connect your driving and driven machinery with a Falk Steelflex Coupling—the all-steel coupling with the exclusive grid-groove design! First, its *torsional resilience* smothers shock and vibration; and second, the Steelflex design prevents damage and lowered efficiency by accommodating shaft misalignment.

Why have increasing numbers of key men in industry standardized on Falk Steelflex Couplings? Their experience has proved that Falk Steelflex Couplings prolong the service life of their machinery... are trouble-free and need minimum maintenance... are easy to install, lubricate and disconnect... and *cost less per year of service* than ordinary couplings.

One basic Steelflex design—the type F, in its many sizes—is adaptable to more than 90% of all industrial applications. For applications involving danger from overloads, Modified Type FT Controlled Torque couplings (see column at left) are ideally suited. There are numerous other special or dual purpose Steelflex couplings for unusual applications. **Write to Department 247** for engineering bulletin, including selection and dimension tables.

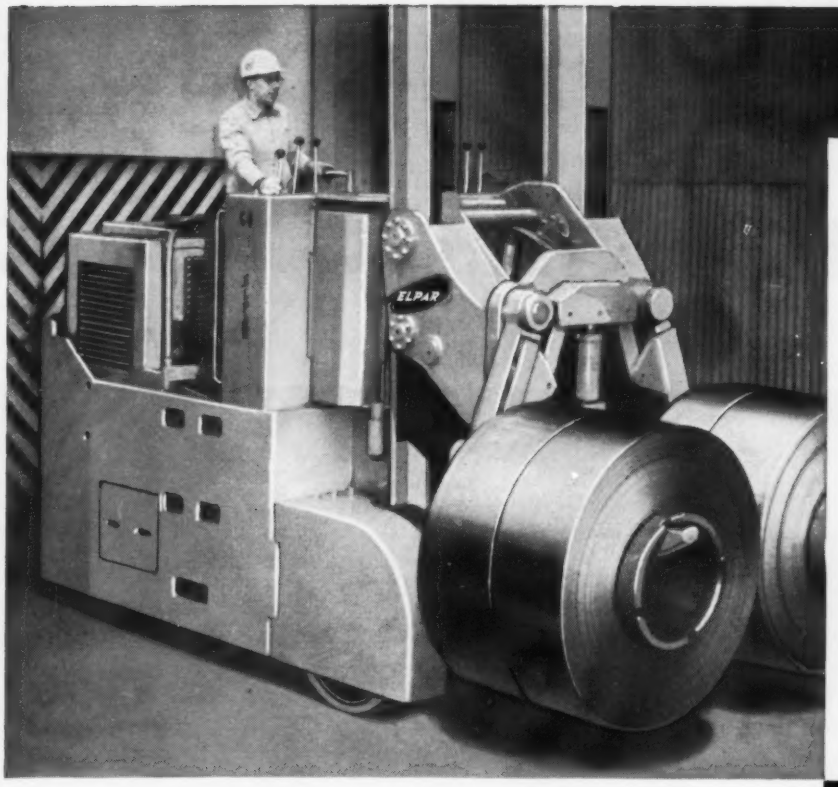
THE FALK CORPORATION, MILWAUKEE, WISCONSIN

FALK

...a good name in industry

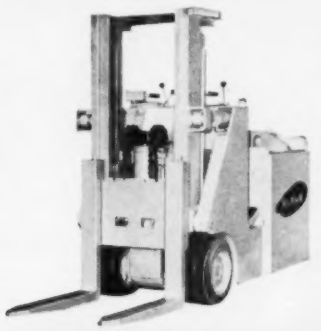
MANUFACTURERS OF:

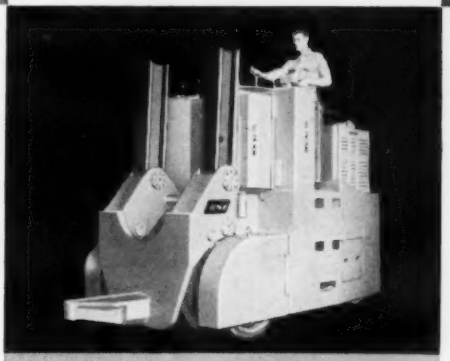
- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

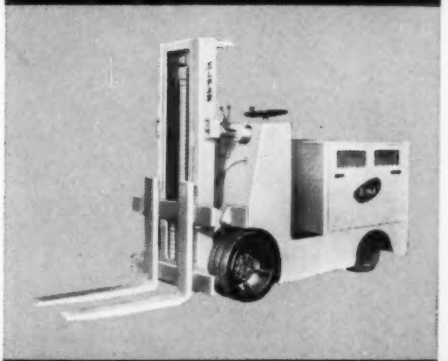


ELPAR

FORK AND RAM TRUCKS







Leader In Heavy Duty Trucks For Metalworking Plants

CAPACITIES FROM 2,000 TO 100,000 LBS.

Metalworking plants — where handling is toughest — demand the kind of rugged trucks that have been an ELPAR specialty for more than 50 years.

Electric power assures dependability and low operating cost. Reduced maintenance . . . space saving economy . . . greater safety . . . easy handling . . . remarkable operating efficiency — are other essential truck features that metalworking plants demand. ELPAR trucks provide them all, plus, a complete line of trucks from the smallest narrow aisle stacker to huge steel handlers.

Ask your local ELPAR man to show you the features of cost-cutting ELPAR trucks built especially for rough service. There's sure to be one that suits your needs exactly.

WRITE FOR THIS NEW LITERATURE . . .

- New FORK TRUCK Bulletin — 2,000 to 10,000 pounds capacity.
- New R-10T Bulletin — 4,000 to 10,000 pounds capacity.
- New TITAN Bulletin — 12,000 to 25,000 pounds capacity.
- New HERCULES Bulletin — 20,000 to 100,000 pounds capacity.

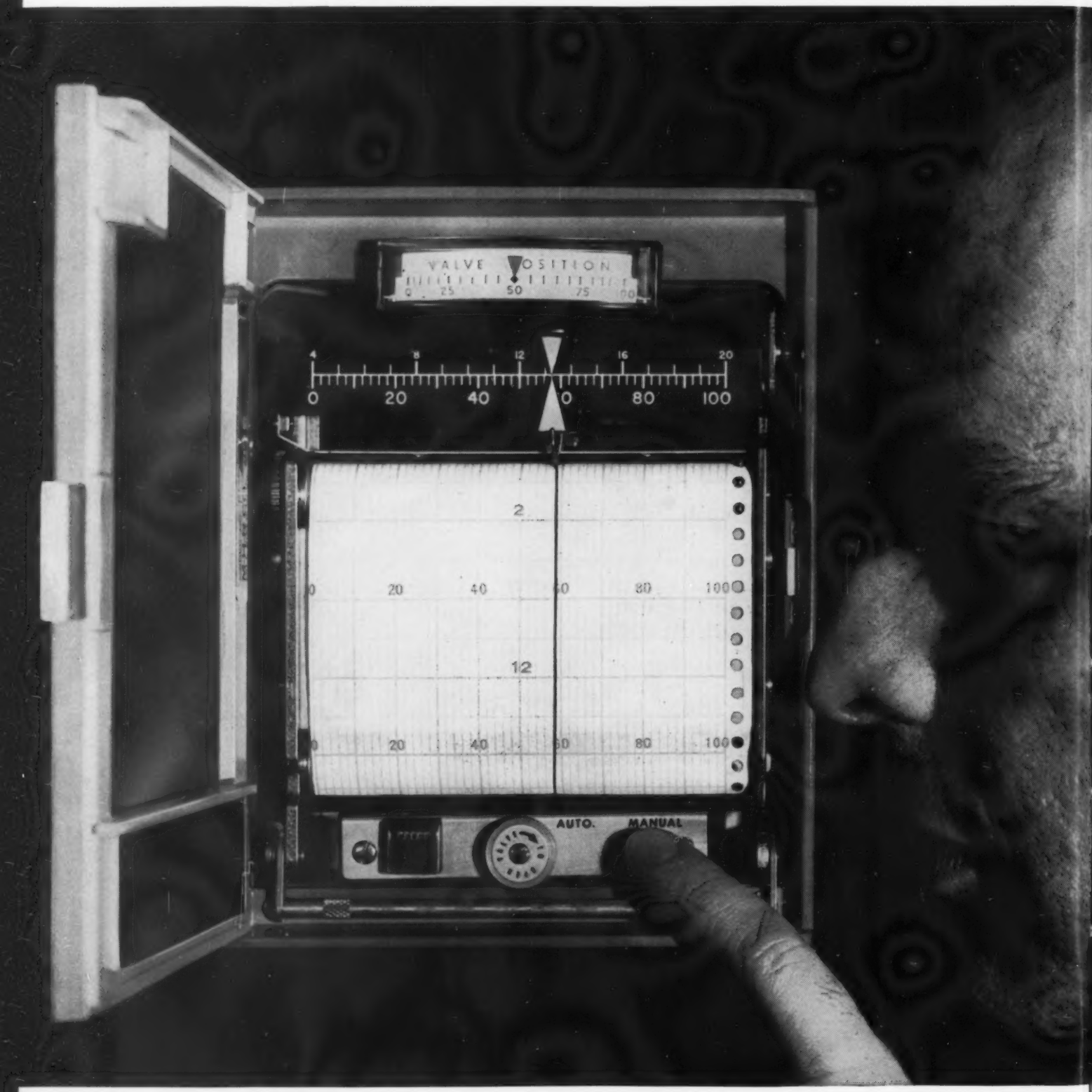
ELPAR

ELECTRIC TRUCKS

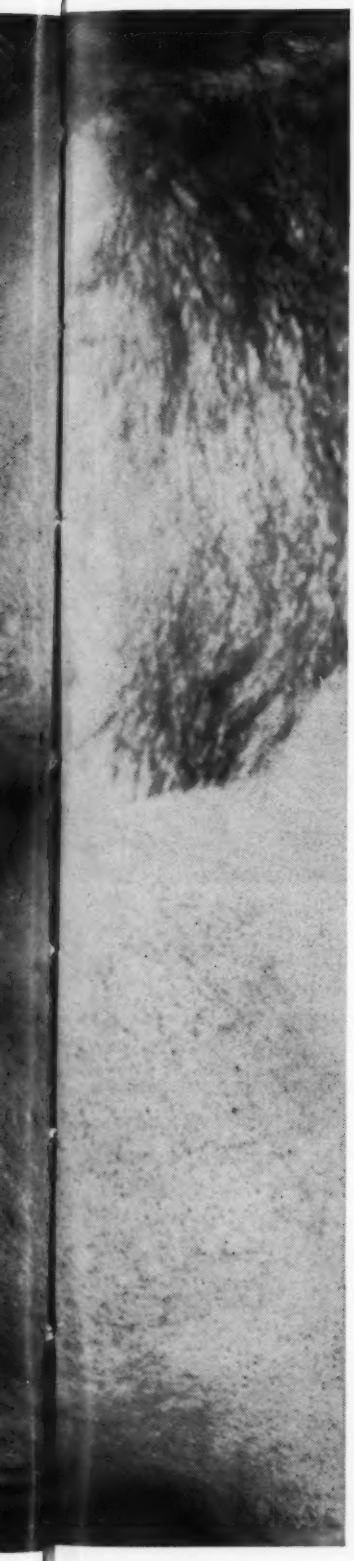
THE **ELWELL-PARKER** ELECTRIC COMPANY
4549 ST. CLAIR AVENUE • CLEVELAND 3, OHIO
In Canada: International Equipment Company, Ltd.

TWICE THE LIFE... ONE-THIRD THE OPERATING COST

New *ElectriK Tel-O-Set*... e
needs in a single compact c



..everything an operator ct control station



This Honeywell electric control station meets all of your requirements for operator convenience.

One compact case houses *every* function the operator needs to supervise a control loop: indication of process variable and set point on the same scale; the controls needed to switch from automatic to manual; controls for manual control; and indication of valve position.

The *ElectriK Tel-O-Set* control station assures easier bumpless transfer than ever before available because there's no need to "line up" or "match" pointers. A null balance indicator eliminates guesswork, and the transfer doesn't have to be hurried since the valve remains under control during the transfer.

You can also order the controller with the proportional band, rate, and reset adjustments on the front of the panel conveniently located below the control station, or at the rear of the panel.

These are just a few of the features that make the new *ElectriK Tel-O-Set* control system an outstanding value. Your Honeywell engineer can give you complete details. Call him today . . . he's as near as your phone.

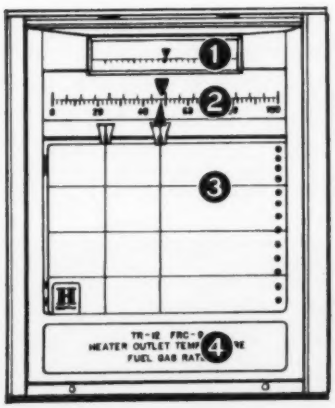
MINNEAPOLIS-HONEYWELL, Fall River, Massachusetts.

75th YEAR PIONEERING THE FUTURE

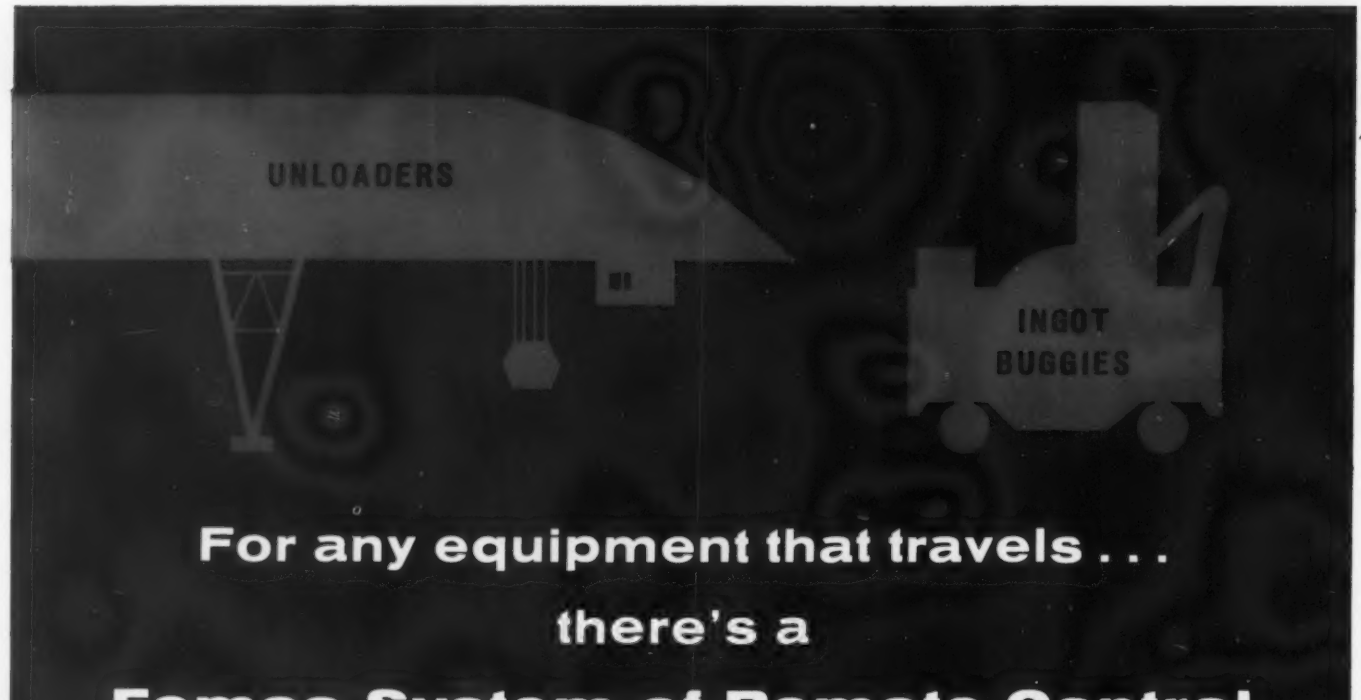
Honeywell

First in Control

SINCE 1885



1. Valve position indicator continuously indicates controller output when on automatic control.
2. Set point index is conveniently located on same scale as process-variable pointer; you can see from a distance any deviation of variable from set point.
3. Rectilinear 4-inch calibrated chart is easy to read. At standard chart speed, four hours of recording is always visible. Unit has daily chart tear off or 30-day rewind. Both recorder and control station take the same 5½" x 6" panel cutout.
4. You get bumpless switching from automatic to manual control because you don't have to match pointers. In the balance position, the valve position indicator is part of a null circuit that compares controller output and manual output. When indicator reads 50%, both outputs are perfectly matched.



Overhead cranes . . . ingot buggies . . . transfer cars . . . electric mules . . . unloaders . . . quench cars—in fact, virtually every type of traveling mill equipment—can be operated by a FEMCO Remote Control System.

These systems cover a wide range of operations: simple remote control of a visible process; remote control and position indication of a hidden process; automatic remote control and position indication of a repetitive process.

Control and indication signals are transmitted over existing power circuits by utilizing carrier frequencies. As many as eight pieces of equipment on a single power circuit may be controlled in this way, simply by using different frequencies.

Control consoles may be in any location desired, either individually or grouped together. Substations may be provided to permit control from various points, or the control station may be mounted on wheels and moved from point to point as needed.

For full information on Femco Remote Control Systems, write to FEMCO, INC., IRWIN, PA. Details about the specific applications in which you are interested will be helpful.

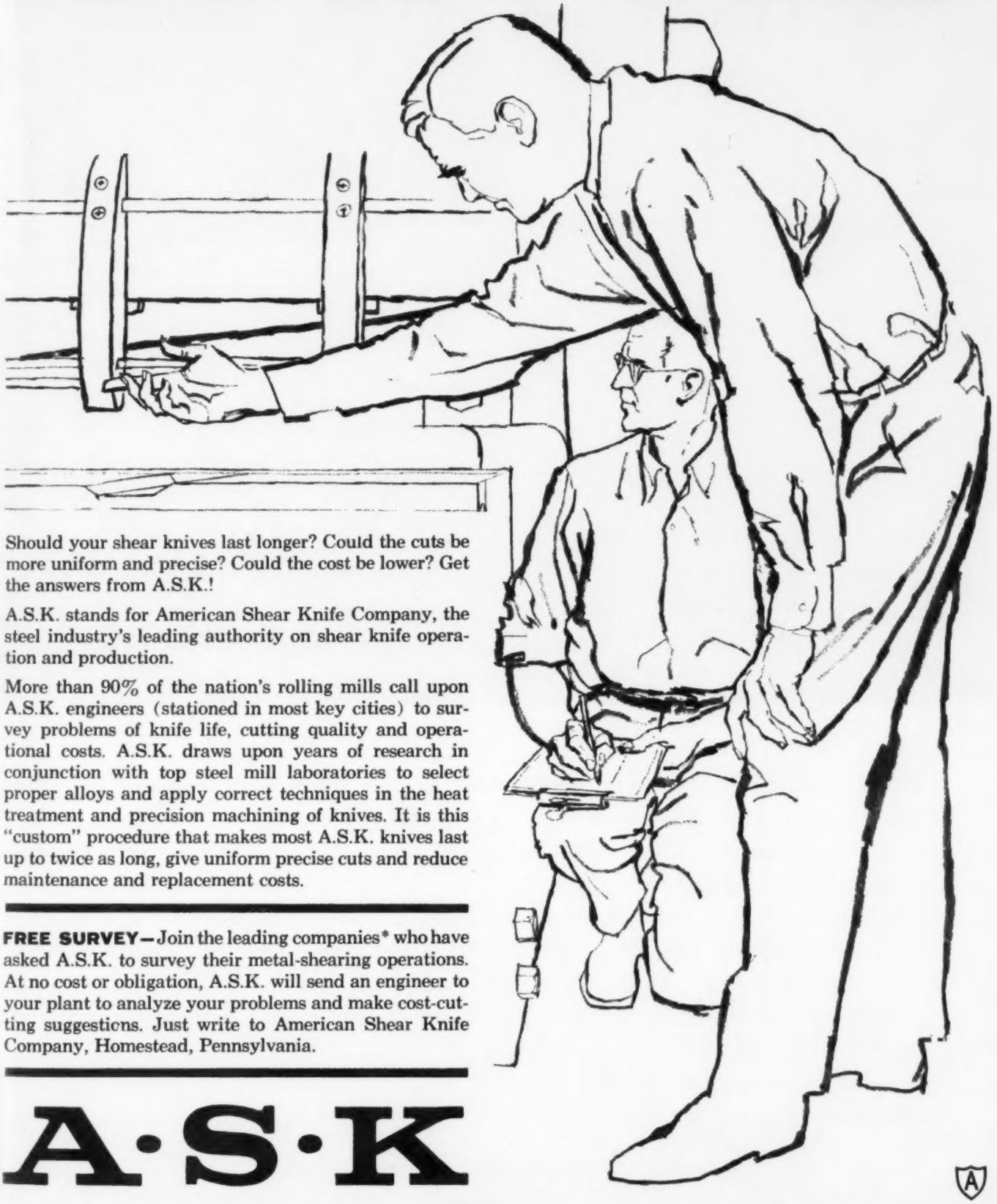
A-101

Femco

COMMUNICATIONS: Carrier and wired audio systems for all mining and industrial applications. **MONITORING:** Fans, circuit breakers, valves, pumps, compressors, etc. **TELEMETERING:** Flows, pressures and other functions. **REMOTE CONTROL:** Pumps, valves, circuit breakers; soaking pit covers, furnace doors; cranes, or other moving equipment.

Can you get more wear from your shear knives?

A·S·K for the answer!



Should your shear knives last longer? Could the cuts be more uniform and precise? Could the cost be lower? Get the answers from A.S.K.!

A.S.K. stands for American Shear Knife Company, the steel industry's leading authority on shear knife operation and production.

More than 90% of the nation's rolling mills call upon A.S.K. engineers (stationed in most key cities) to survey problems of knife life, cutting quality and operational costs. A.S.K. draws upon years of research in conjunction with top steel mill laboratories to select proper alloys and apply correct techniques in the heat treatment and precision machining of knives. It is this "custom" procedure that makes most A.S.K. knives last up to twice as long, give uniform precise cuts and reduce maintenance and replacement costs.

FREE SURVEY—Join the leading companies* who have asked A.S.K. to survey their metal-shearing operations. At no cost or obligation, A.S.K. will send an engineer to your plant to analyze your problems and make cost-cutting suggestions. Just write to American Shear Knife Company, Homestead, Pennsylvania.

A·S·K

AMERICAN SHEAR KNIFE

**names supplied on request*

Three Reasons General Electric D-c Drives are Best for Au

1. Costly Maintenance Shutdowns Reduced by

D-c Main Drives

In metal-rolling mills—where minutes of downtime are measured in thousands of dollars—fast, simplified maintenance of main drive motors is critical.

The revolutionary "TOP-FORWARD" twin-drive shown above exemplifies General Electric's continuing emphasis on better design for ease of maintenance. Shaft extension of the rear motor passes *beneath* the forward motor instead of directly over as in conventional designs. This unique drive arrangement allows clear access by overhead crane to all bearings, air-shields and other components of *both motors*.

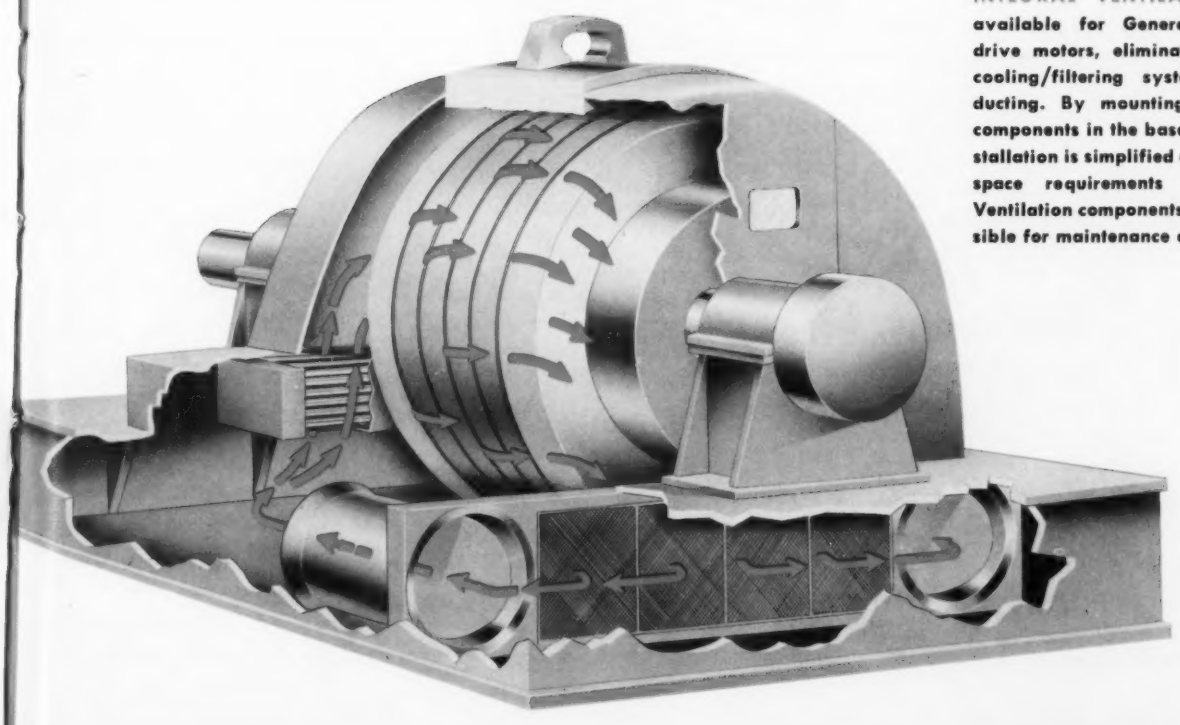
Shorter over-all length of drive substantially reduces space required and provides cost savings in foundation construction. Improved Class B Insulation system for armatures and fields, utilizing proven resins and compounds, provides greater resistance to heat, moisture and dirt.

Progress Is Our Most Important Product

GENERAL ELECTRIC

for Automated Production Systems

d, by New Advances in D-c Drive Design

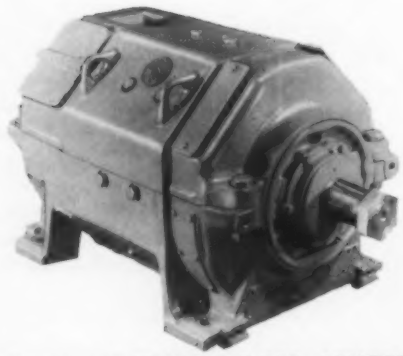


INTEGRAL VENTILATION SYSTEM, **available for General Electric main drive motors, eliminates separate air-cooling/filtering system and related ducting. By mounting all ventilation components in the base of the drive, installation is simplified and supplemental space requirements are eliminated. Ventilation components are easily accessible for maintenance and inspection.**

Three Reasons General Electric D-c Drives are Best for Au

2. G-E Drives Are Durable and Reliable— M

D-c Auxiliary



GENERAL ELECTRIC'S MD-600 ARMORED MOTOR is built to withstand severe shocks, give maximum reliability. Class H insulation provides superior protection—permits greater work capacity.

Designed to exceed the requirements of the most advanced continuous processing systems, General Electric MD-600 series armored mill motors are built to withstand regular exposure to hot scale, steam and corrosive sprays. Improved high temperature insulations have appreciably lengthened motor life.

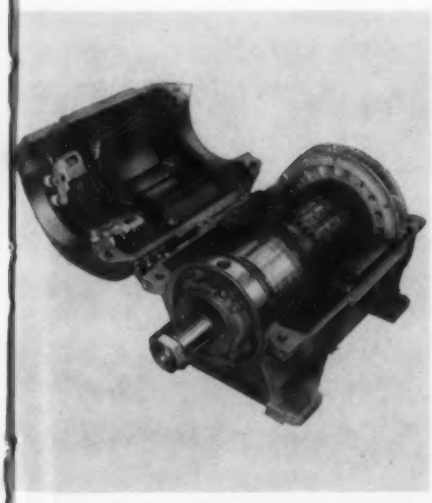
Designed to meet or exceed AISE standards in all respects, General Electric's armored motor offers unmatched flexibility. This motor can be adapted to fit any of five different ventilation requirements simply by adding or removing standard covers. No other modifications are necessary.

Progress Is Our Most Important Product

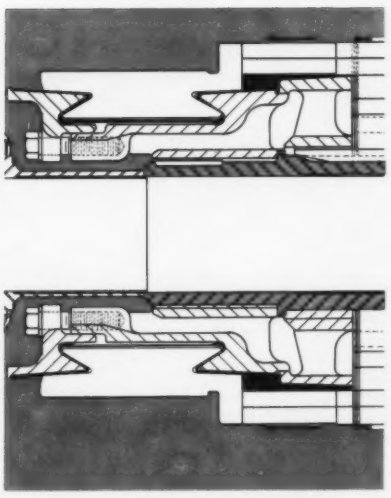
GENERAL ELECTRIC

for Automated Production Systems

— Meet Demands of Continuous Processing



DESIGNED FOR EASY ACCESS, top half of General Electric MD-600 motor frame swings open nearly 180° to permit fast armature removal. Positioning keys in frame heads facilitate armature alignment.

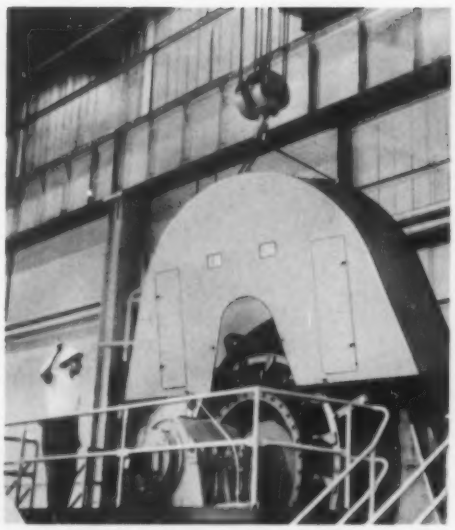


DESIGNED FOR EASE OF MAINTENANCE, the armature on General Electric armored motors is assembled on a steel spider so the shaft can be pressed out without disturbing commutator or windings.

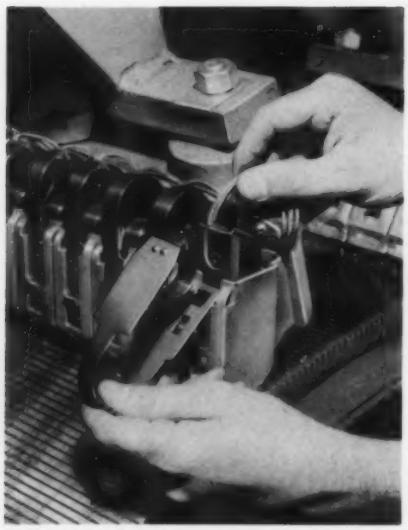
BUILT TO DRIVE HEAVIER LOADS—accelerate, start, stop and reverse faster—MD-600 motors meet toughest demands of automated systems. Integral feet on the endshields allow the armature to stand alone when removed from frame.

Three Reasons General Electric D-c Drives are Best for Au

3. G-E Drives Give You New Competitive Ac



NEW QUICK-REMOVABLE COVERS use no bolts, permit easy access. Tapered guide pins, attached to "TOP-FORWARD" d-c main drive motor frame, accurately position covers on base and frame. Removal and replacement time is reduced to a minimum.



CONSTANT-PRESSURE BRUSH-HOLDERS eliminate all pressure adjustments, give optimum contact at all times. General Electric brush-holder design permits observation of brush wear. Brush can be replaced in seconds.

DISC-LUBRICATED BEARINGS provide positive oiling during all operating conditions. Self-aligning, cast-steel, babbitt-lined bearings can be removed without disconnecting oil piping—maintenance is simplified.

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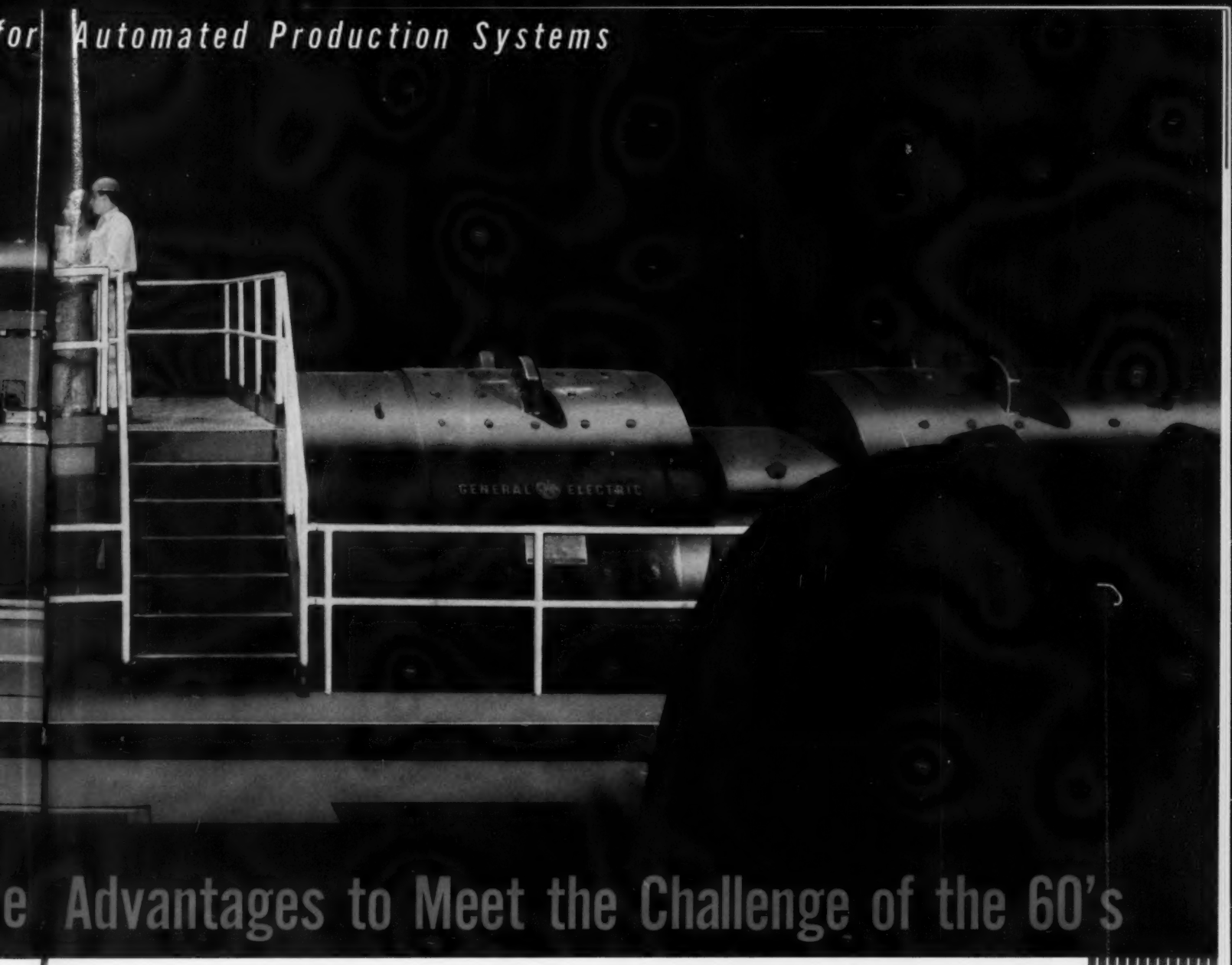
for Automated Production Systems



e Advantages to Meet the Challenge of the 60's

Higher processing speeds, tighter production schedules and better product quality are requisites of industrial growth in the coming decade. As continuous processing and automation techniques spread throughout industry, rapid maintenance of basic equipment becomes an increasingly important competitive advantage.

General Electric's simplified-maintenance drive design gives you this advantage plus the high thermal and mechanical limits and improved commutation demanded of automated processes.

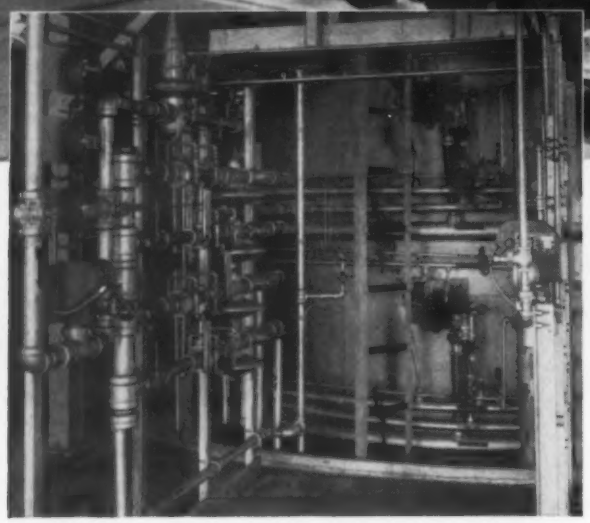
Let your G-E Sales Engineer show you how easily new d-c main and auxiliary drives can fit into your modernization plans, improve operating efficiency and help you meet the challenge of the '60's. For descriptive information on d-c motors for heavy industry, write Section 772–9, General Electric Co., Schenectady 5, N. Y. *Large Motor & Generator Dept., Schenectady, N. Y./Direct Current Motor & Generator Dept., Erie, Pennsylvania.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

D-c Main & Aux. Drives

Minimize Rejects–Maximize Savings
with North American Burners, Blowers, and Controls



3 Car Type Furnaces are top and bottom fired with 38 Dual-Fuel XSA Burners each in 3 zones. NA Adjustable Port Valves and #16 Regulators provide correct fuel-air ratio at high fire, progressively throttle fuel faster than air to 250% excess air at low fire.

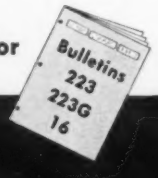
5 Pit Type Furnaces (8' x 18') are each fired by 16 Dual-Fuel XSA Burners in 2 zones. NA Valves and Regulators adjust gas & oil input; air stays constant. Fuel turndown is 5:1, but effective heat turndown is infinite—even to controlled cooling.

NORTH AMERICAN
XSAir Combustion System gives extra controllability

National Forge Company needed a uniform temperature *throughout* every load of crankshafts—not just at the controlling pyrometer locations—so they selected a North American XSAir Combustion System to do this critical job.

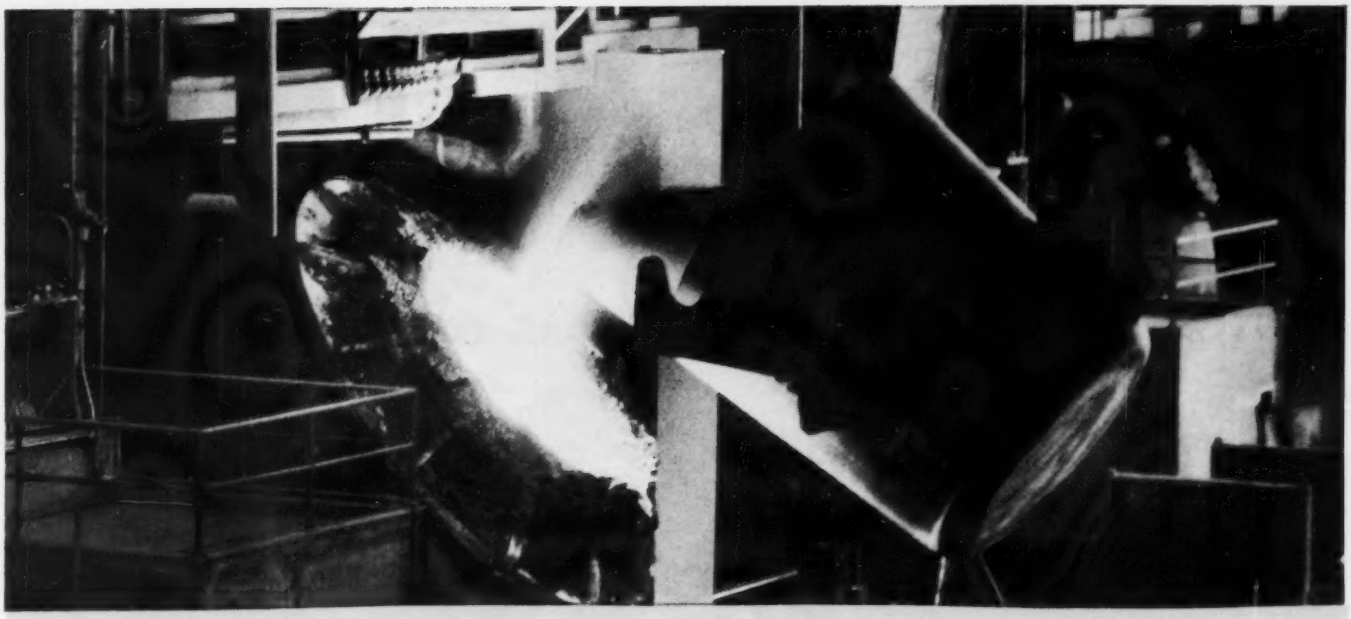
You can't eliminate hot spots and cold corners by merely controlling an *average temperature*—you must also limit the temperature extremes everywhere in the furnace. The XSAir System does this by bringing the maximum and minimum temperatures closer together.

For engineering information, call your nearby North American Combustion Engineer or write for



NORTH AMERICAN for COMBUSTION and Hydraulic Controls

The North American Mfg. Co.
Cleveland 5, Ohio



ANOTHER BASIC OXYGEN INSTALLATION...

FURNACES BY PECOR

America's first 13 oxygen steel furnaces have been fabricated by Pennsylvania Engineering, and two more are under construction now. PECor helped pioneer this process and has fabricated much auxiliary equipment to supplement the converters.

With a rich background of experience in this highly specialized product, Pennsylvania Engineering can contribute significantly to any oxygen steelmaking installation. With a PECor Oxygen Furnace you are assured of sound design, precision fabrication, smooth operation and on-the-spot service.

May we discuss oxygen steelmaking with you?

Illustrated above . . . one of three Pennsylvania Engineering furnaces in an L-D Process installation at Kaiser Steel Corp., Fontana, California.

BASIC OXYGEN FURNACE (L-D) SCOREBOARD
BUILT OR BEING BUILT BY PECor

Steel Producer	Furnaces	Rated Capacity
Jones and Laughlin Steel Corporation	4*	2 @ 65/100 Tons 2 @ 162/200 Tons
McLouth Steel Corp.	6	3 @ 110 Tons 3 @ 60 Tons
Kaiser Steel Corp.	3	65/100 Tons
Acme Steel Company	2	50 Tons

*When two new 162/200 ton furnaces are operating.

PENNSYLVANIA ENGINEERING CORPORATION

NEW CASTLE, PENNA.

Sales Representatives

Wooldridge Co., Burlingame, Cal. **Fred Middleton Co. Inc., Birmingham, Ala.**

ENGINEERS • FABRICATORS

OTHER STEEL PLANT EQUIPMENT WE BUILD

Blast Furnaces **Open Hearth Furnaces** **Hot Metal Mixers** **Hot Metal Mixer Cars** **Ladles** **Ladle Transfer Cars** **Scrap Cars** **Slag Cars** **Ore Transfer Cars** **Thermo Metal (Bottle) Cars** **Jack Cars** **Ingot Cars**

Ohio Rolls

SHAPING METAL FOR ALL INDUSTRY

Ohio Iron and Steel Rolls

- FORGED AND HARDENED STEEL ROLLS
- Carbon Steel Rolls
- Ohioloy Rolls
- Ohioloy "K" Rolls
- Flintuff Rolls
- Double-Pour Rolls
- Chilled Iron Rolls
- Denso Iron Rolls
- Nickel Grain Rolls
- Special Iron Rolls
- Nioloy Rolls

THE OHIO STEEL FOUNDRY CO., LIMA, OHIO

PLANTS AT LIMA AND SPRINGFIELD, OHIO... *Virtually at the center of the steel industry*

Industry News...

MODERNIZING PROGRAM BEGINS AT HAMILTON

△ A $6,000,000 modernization and rebuilding program has begun at the Hamilton, Ohio, plant of Armco Steel Corp., C. G. Davies, vice president and general manager, Armco Division, announced. The Hamilton plant serves the steelmaking facilities of the Middletown Works.

"When the entire job is completed early in 1961, the Hamilton plant will be completely modernized and its efficiency greatly stepped up," Mr. Davies said.

Major projects now underway include the dismantling and rebuilding of coke oven battery No. 1 and the relining of No. 2 blast furnace.

The No. 1 coke oven battery, largest at the Hamilton plant, was first put into operation in 1928. When rebuilt, battery No. 1 will have 45 ovens, the same number as before.

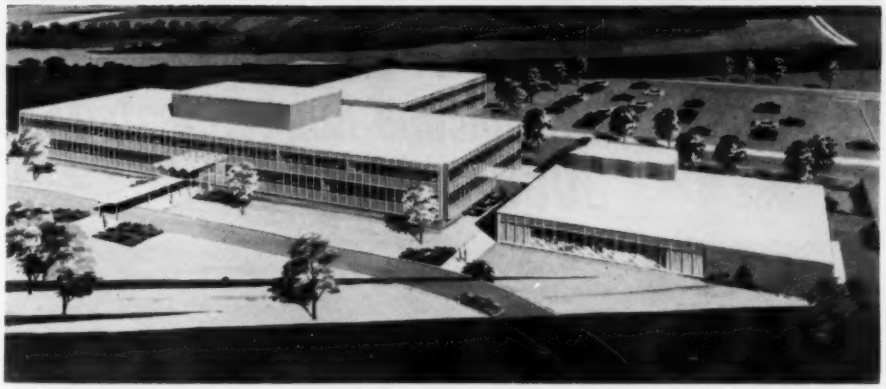
The rebuilding of battery No. 1 is expected to be completed in April or May of next year. While the work is underway, battery No. 2 with 15 ovens and batteries No. 3 and 4, which have 25 ovens each, will continue to produce coke.

Batteries No. 2 and 3 were recently put back into operation after being shut down for six months for modernization. New self-sealing doors were installed on these ovens and new door machinery placed into operation. Battery No. 4, built in 1948, already has these modern features.

Upon completion of the rebuild of battery No. 1, the Hamilton coke plant will have the modern features of a completely new coke plant, Mr. Davies said. Doors on all 110 ovens will be handled by the same type of door machines. Two new coal charging cars will be added. As a result, the entire operation of charging coal into the ovens and the pushing of coke out of the ovens will be greatly improved. Koppers Co., Inc., has the contract for the coke plant work.

The job of relining No. 2 blast furnace, which was started about

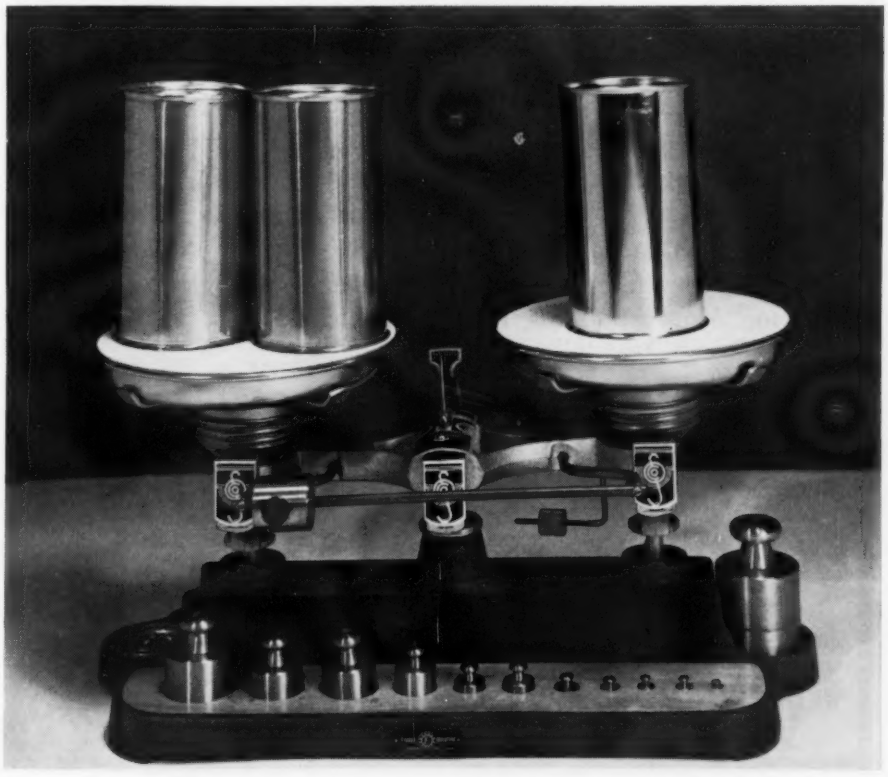
BUILD NEW OFFICE AND RESEARCH FACILITIES



Weirton Steel Co.'s new general office building is shown as it will appear on completion next year. Ground was broken April 22 in Weirton on a 375-acre site where the office building and a new National Steel Corp. Research and Development Center will be located. The two-story Research and Development Center will incorporate the latest engineering features. Half the building will house office and bench laboratory facilities and the other half will contain the pilot plant area. The laboratory section of the Research Center will include the most advanced tools for research as well as an extensive technical library. The pilot plant area will house facilities for studies in coke making, sintering, steelmaking and the coating of steel products. The general office building will consist of a basement and two floors, and will have approximately 150,000 sq ft of floor space, or about three times the area of the present general office building.

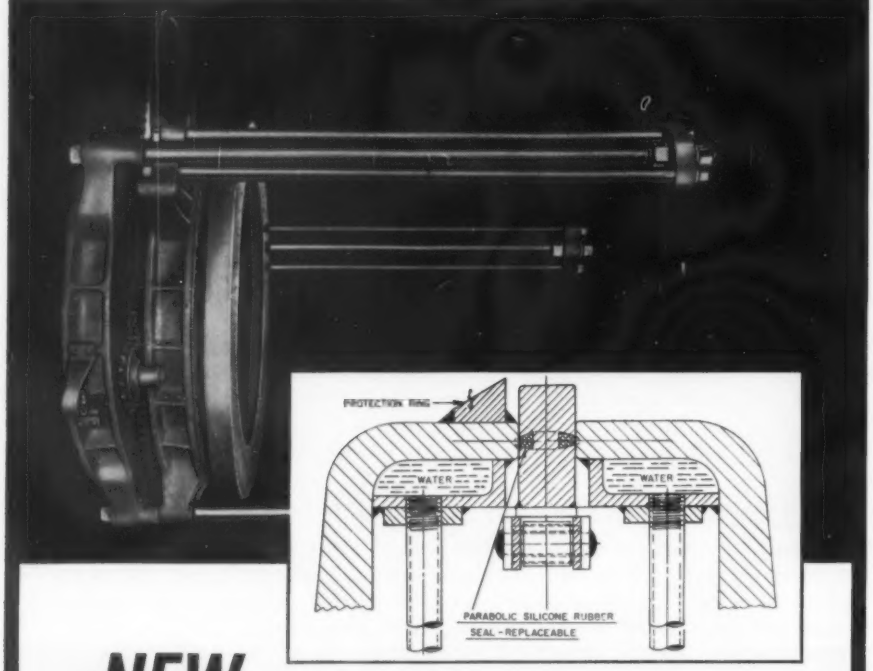
NEW TINPLATE CUTS CAN WEIGHT

The two cans at left are made from U. S. Steel Corp.'s new thin tinplate, which cuts can weight almost in half. Can producers are taking a close look at the new product to learn how great an economic potential it offers. Facilities for commercial production are now in the experimental stage.



World's First

Water-Cooled, Silicone Rubber-Seated GOGGLE VALVE



NEW... GAS-TIGHT Service for High Pressure Furnaces

Designed for use between dustcatcher and washer, this valve features parabolic silicone rubber seats in the goggle plate, and water cooled flanges. Design provides a tighter, more gas-proof seal than is possible with metal-to-metal seals. *Write for Bulletin V-200.*

BAILEY *Thermal Expansion* GOGGLE VALVES

WILLIAM M. BAILEY COMPANY · 1221 BANKSVILLE ROAD · PITTSBURGH 16, PA.

the middle of April, is nearing completion. No. 1 blast furnace was relined last fall.

Mr. Davies also pointed out that a new $265,000 water softening unit is being installed at the Hamilton plant to treat raw well water for use as blast furnace cooling water and boiler water. Chemical treatment of the water will reduce scaling and corrosion in blast furnace and boiler piping.

INSTALLS NEW SOAKING PITS AND RECUPERATORS

△ The first installation of Escher recuperators in an American steel mill have been placed in operation at the Huntington, W. Va., Works of Connors Steel Div., H. K. Porter Co., Inc. The recuperators will supply preheated air to two new soaking pits at the plant.

The recuperators and soaking pits represent one of the final phases in a $1,600,000 expansion program at the Porter facility aimed at doubling its steelmaking capacity and at the same time providing greater flexibility of operation.

Installed by the Rust Furnace Co., the recuperators are constructed of alloy steel plate and standard steel shapes. Rust officials assert that an Escher recuperator may function up to ten years without major maintenance because of its relatively simple design and metal construction. During that time, very little falloff in efficiency can be expected, they add.

The new soaking pits, which will take over part of the load now borne by several older units, also represent a unique effort in steelmaking by Connors; they mark the first time a steel producer has completely lined a new soaking pit with plastic refractory materials. Connors used Porter Pitco, a super duty plastic refractory produced by the Porter Refractories Division. Pitco is expected to provide considerably more resistance to abrasion than the standard refractories usually used in soaking pits. This factor, plus greater ease in patching, is expected to lower refractory cost by as much as one half over the life of the linings.

The new soaking pits are of single-fired design. Each has a 100 ton ingot capacity. The West Virginia Works currently operates an electric

WANT TO SAVE SOME MONEY?

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Want to increase the current rating of your URELITE breaker? Just reset the trip devices. It takes only minutes. Expanded ranges eliminate shutting down the circuit and replacing devices. Calibration is directly in amperes for easy, accurate setting.

Send for new illustrated Bulletin 4261-2b. I-T-E Circuit Breaker Company, Dept. SW., 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

furnace having a rated annual capacity of 117,000 tons. A second electric furnace is now being installed, for operation by midyear.

INLAND WILL REVAMP NO. 2 TINNING LINE

△ Inland Steel Co. has announced a program that will enable it to process two-thirds of its tinplate output in coils by revamping its No. 2 electrolytic tinning line at its Indiana Harbor Works.

The project will be the second undertaken by Inland to increase its output of tinplate in coils. The first occurred last year when the company began construction of a third electrolytic tinning line, scheduled to go into production late this summer.

The company stated that it will convert its No. 2 line from the production of cut lengths to coils of tinplate. The program will take a year with the first coils expected to roll from the line during the summer of 1961.

Completion of this project and the No. 3 line will enable Inland to step up its delivery of tinplate in coils. The company's present production is restricted to sheets.

The revamped line will have a capacity of 11,000 tons a month compared with the 14,000 tons of monthly capacity expected from the company's new third line. Following expansion and conversion of its tinplating facilities the company's annual production capacity of tinplate will be 435,000 tons.

The conversion will affect only the delivery end of the line. The present rotary shear and stacking equipment will be removed. In their place coiling equipment will be installed, including a delivery looper tower, gage measuring stand, tension bridle, mash welder, repeat coiler, double and snip shear and two tension reels.

Inland's No. 1 line will continue to produce tinplate in sheets.

The tin mill expansion is part of Inland's $80,000,000 capital investment program for 1960. It includes underground development of its Canadian iron mining operation, modernization of its Chicago Heights rail re-rolling mill, the tin mill expansion, enlargement of its wide flange beam capacity, construction of its new ore vessel and the addition of a continuous galvanizing line.

ENGLISH MILL CONTRACT IS AWARDED TO UNITED

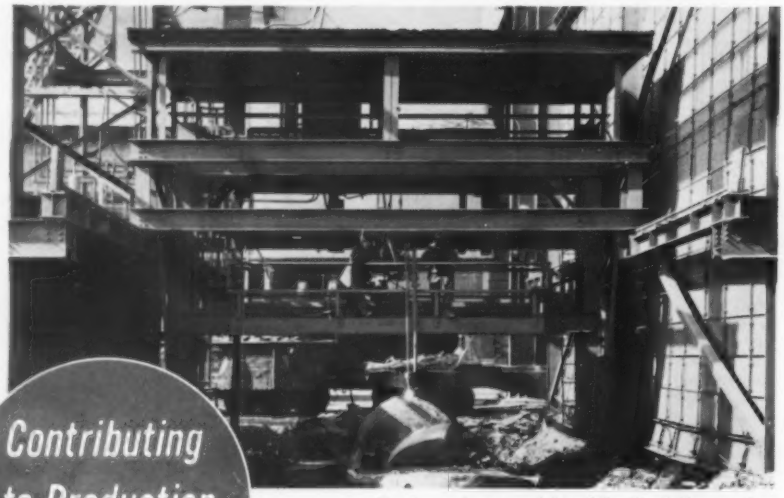
△ United Engineering and Foundry Co. has been awarded an order for a universal slabbing mill, a four stand tandem cold mill and a temper pass mill, by Richard Thomas and Baldwins, Ltd., of England.

These mills are to be installed at the new Spencer Works which will be a completely new integrated plant located at Llanwern, near Newport, Monmouthshire, and are scheduled to go into production in late 1961.

WORK UNDERWAY ON NEW INTERLAKE SINTER PLANT

△ Foundation pouring is nearing completion and structural work is underway for a new continuous iron ore sinter plant at Interlake Iron Corp.'s Chicago, Ill., plant. The sinter plant, being built by Dravo Corp. under license from Lurgi Co.

TITZEL CRANES



Courtesy—Jones and Laughlin Steel Corporation

Contributing to Production Efficiency

in Steel Plants and Allied industries

Titzel Cranes are designed and built to meet specific individual requirements. The above picture shows a Button and Skull Burning Crane. Every Titzel Crane installed provides smooth, safe, dependable operation and gives consistently efficient, long-lasting performance. For complete information write or phone MUseum 1-9622.

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- Hot Topping and Capping Cranes
- Jib, Pillar, Wall and Floor Traveling Cranes
- Cover Cranes for Steel and Aluminum Plants
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- Stopper Rod Drying Ovens
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Since 1928 TITZEL ENGINEERING, INC.
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ALLIED COMPANY, TITZEL ENGINEERING & EQUIPMENT CO.

of Germany, will have a capacity of 3360 net tons of sinter a day and will be equipped with a straight-line, induced draft cooler.

The single-strand sinter machine will be 8¼ ft wide and 151 ft from center to center of the sprockets. The 101 ductile iron pallets will travel over 19 windboxes with a suction area of approximately 1022 sq ft, at speeds up to 17½ fpm.

The 224-ft long cooler will lower the temperature of hot sinter from 1450 F to approximately 235 F. Three 270,000-cfm fans, each powered by 250-hp motors, will draw air through the sinter as it is carried along on 11½-ft-wide trays.

Six Dravo-Schenck vibrating screens or feeders will help transport the sinter material to and from the cooler. Two units will feed and screen hot sinter from the breakers to the cooler; two others will feed and screen cold sinter coming off the cooler. Two small units will be used to handle hot fines and spillage.

Mixing and processing the raw ore fines, coke, flue dust and limestone will necessitate installation of eight 25-ft diam by 55-ft high storage bins, pug mills, a balling drum, sinter dust collectors, apron feeders, conveying and auxiliary equipment.

Dravo also will install scalping and screening equipment for the incoming ore and miscellaneous materials as well as coke grinding facilities.

FIRM ANNOUNCES THREE SALES REPRESENTATIVES

△ Cleveland Worm & Gear and Farval Divisions of Eaton Manufacturing Co. have announced the appointment of new engineering sales representatives in Cleveland, Pittsburgh and Philadelphia to replace The Dingle-Clark Co. which recently announced its retirement from the agency business. The three agencies which now represent the two Eaton divisions are being operated by former executives of Dingle-Clark in those cities.

In Cleveland, the R. V. Robison Co. becomes the exclusive engineering sales representative in that area. Mr. Robison had been in charge of the Cleveland office of Dingle-Clark. The J. P. Murray Co. has evolved from the Dingle-Clark organization in Pittsburgh. Mr. Murray was formerly in charge of the Pittsburgh office.

In Philadelphia, W. M. Stilwell has formed a sales agency under his name as an outgrowth of the former Dingle-Clark office to represent Cleveland Worm & Gear and Farval in that area.

HARBISON-WALKER OPENS NEW WESTERN OFFICE

△ The Harbison-Walker Refractories Co. has announced that a new western district sales office with headquarters in Los Angeles, Calif., was opened on May 1. The new office is managed by Mr. C. F. Wenrich, a member of the Harbison-Walker sales staff since 1946, and a sales representative in the San Francisco office since 1951.

The new western district comprises all of California below the northern boundaries of Inyo, Kern and San Luis Obispo counties, portions of Nevada, the entire state of Arizona; and the State of Baja California in the Republic of Mexico.

Air Conditioned Crane Cab

..Built..Air Conditioned

and guaranteed by Lintern

Lintern air conditions existing cabs and also builds solid, well insulated replacement cabs to your requirements.

This new Lintern cab complete with air conditioning is shown as it was being installed at National Tube Division of United States Steel, Lorain, Ohio. In the same plant Lintern crane cab heaters as well as air conditioning equipment have been installed on new cranes.

Contact your local Larco representative or write:

Larco, inc.
DISTRIBUTOR OF LINTERN CORPORATION PRODUCTS
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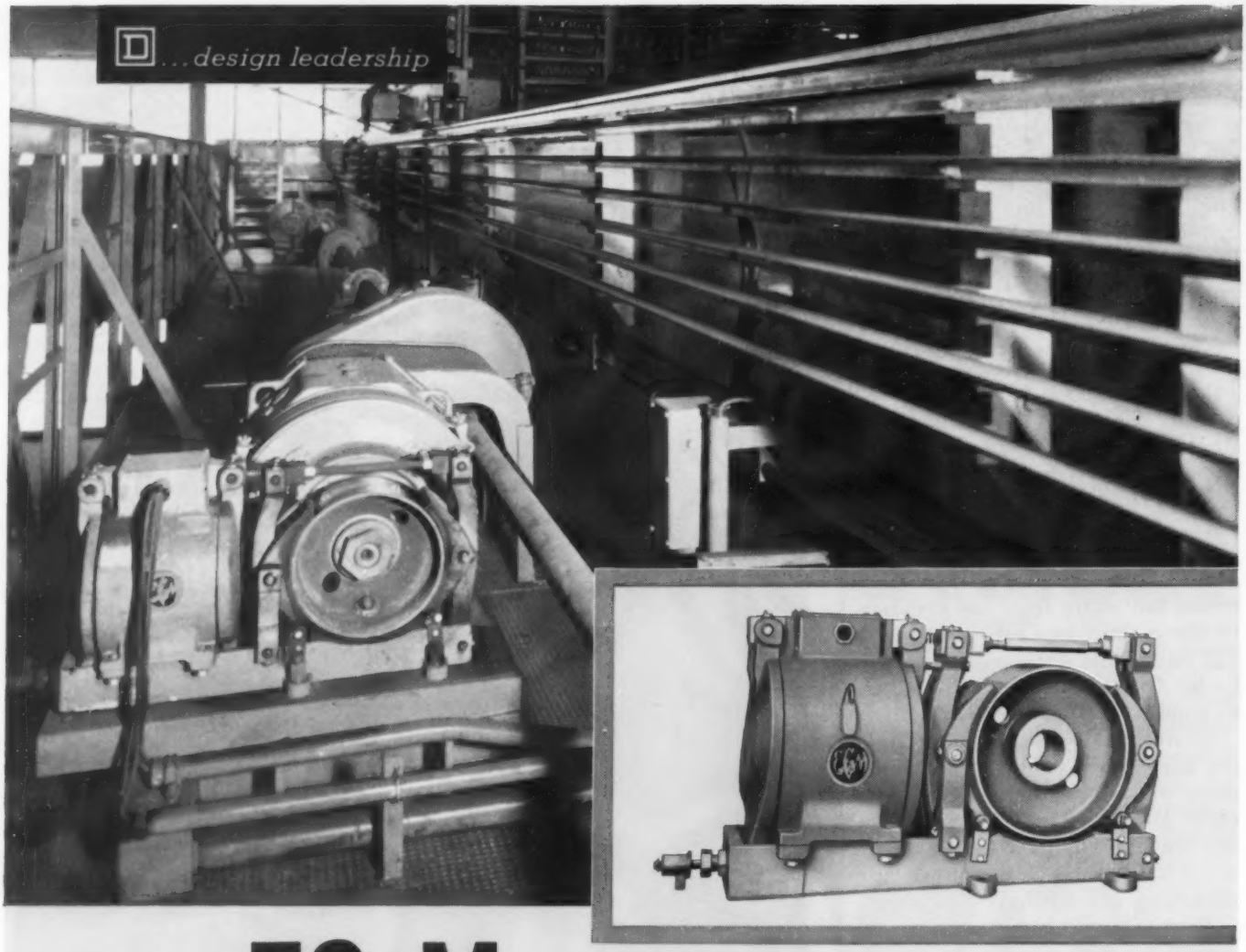

NEW EC&M ELECTRIC BRAKE for both PARKING and SERVICE

For the first time, here is an all-electric brake which combines an emergency or parking brake with a service brake. The new **AT** (**A**djustable **T**orque) brake was primarily designed for EOT crane bridge drives, but is equally well suited for travel motions on transfer cars, coke pushers and similar applications.

The new **AT** brake has important advantages. There are no hydraulic or air lines which can be affected by vibration or temperature extremes. Being electrically operated, the **AT** brake can be used with man-trolley and floor-operated cranes.

The new EC&M brake consists of two magnets and two armatures on a single frame. An easy-to-operate foot pedal applies 3 points of adjustable torque for controlled service braking. In addition, a separate spring-applied torque provides parking and emergency braking on power failure. Both service and emergency braking torques can be adjusted independently to fit the application.

The new **AT** brake is easy to install and maintain. Only three control leads (or collectors) are required for brake operation. **AT** brakes meet all AISE ratings and mounting dimensions.

For further information, contact your local Square D Field Engineer, or write
Square D Company, EC&M Division, 4500 Lee Road, Cleveland 28, Ohio

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wherever electricity is distributed and controlled

4533

HARD-SURFACED BELL

By welding 3200 lb of stainless steel "beading" in three separate layers, engineering and maintenance crews at U. S. Steel Corp.'s Columbia–Geneva Division, Provo, Utah, have given this blast furnace bell a special hard surfacing to prolong its service life and make it more resistant to abrasion, corrosion and extreme operating temperatures. Special welding equipment and automatic controls were designed and built at Geneva to impart a thickness of 5/16 in. on the lower seven feet of the cone at a constant welding rate. The process makes possible the renewal of worn out bells for additional use.

MORGAN ENGINEERING CO. LICENSES CANADIAN FIRM

△ The Morgan Engineering Co. has licensed the Dominion Bridge Co., Ltd., of Montreal, Canada, to build and sell Morgan designed equipment throughout Canada. Announced jointly by W. H. Morgan, president of Morgan Engineering, and P. E. Savage, Dominion's vice president, the agreement will enable Dominion to complete its product lines which will now range from industrial, through heavy end equipment.

INLAND STEEL DEDICATES ORE MINING OPERATIONS

△ Caland Ore Co., Ltd., a subsidiary of Inland Steel Co., dedicated, on May 3, its mining operation near Atikokan, Ontario, which will become the largest in the Great Lakes region when it reaches capacity output of 3,000,000 tons a year by 1969.

Caland Ore Co. was founded in 1953 when Inland decided to lease

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IN THE LONG RUN!

More and more plants have standardized on SUPER #3000 for bonding and patching. In the long run, it *costs less* since it "stands the gaff" in places where other mortars fail.

SUPER #3000 — the "NO EQUAL" mortar — is the lowest price insurance you can buy.

SUPER #3000 greatly reduces chance of refractory failure — cuts frequent repairs and maintenance.

BLAST FURNACE — SUPER #3000 pumped into voids in lining to eliminate hot spots. Customer says SUPER #3000 works better in pump than mortar previously used (pumped higher than 200 ft.). Does not clog hose. Excellent patch.

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Manufacturers of Castable and Bonding Refractories; FURNACE BLOK; Blankets, Block, Plastic and Fill Insulations.

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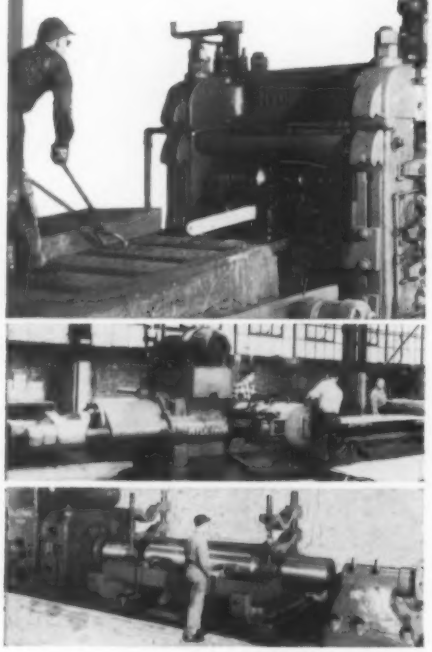
ROLLING MILL EQUIPMENT



Hyde Park Engineers are always ready to co-operate with you in selecting and applying the rolling mill equipment best suited to your operation.

Bar Mills • Merchant Mills
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HYDE PARK
Westmoreland County, Penna.

Rolls
Rolling Mill Equipment
Gray Iron Castings

an ore body beneath the waters of the eastern arm of Steep Rock Lake from Steep Rock Iron Mines, Ltd., the company that discovered ore in the district and started its development.

After three years of exploratory drilling to determine the dimensions and size of the ore body, Caland began massive dredging operations. Over a five year period dredging never stopped as 160,000,000 cu yd of silt overlying the ore body was transferred overland to another lake.

Caland is currently mining iron ore by the open pit method until underground development, already far along, permits underground mining to start in 1963. The company expects to ship 750,000 tons of ore this year. At its capacity operations of 3,000,000 tons a year, Caland will supply one-third of Inland's iron ore needs, making it the steel company's largest single source.

At full operations Caland will employ about 1200 men. Peter P. Ribotto, recently named a vice president of Caland, directs the company's operations in Canada.

INCO TO START NEW OPEN PIT OPERATION

Δ A new mining operation, the Clarabelle Open Pit, will be started by The International Nickel Co. of Canada, Ltd., on an outcropping orebody in the Clarabelle and Lady Lakes area in Ontario.

Part of the long-range program to maintain the continuity of Inco's operations in the Sudbury District, the Clarabelle is scheduled to go into production in the latter part of 1961.

Production from the new open pit will not increase the company's overall output but will replace tonnage now being obtained from other Inco mines.

Preparatory work such as stripping rock overburden and surface plant construction will be started in the immediate future. When required, the necessary mining equipment, including electric shovels, trucks, bulldozers, churn drills and crushers will be transferred from International Nickel's Frood Open Pit, where operations have been gradually approaching completion.

Surface dimensions of the Clarabelle Open Pit will be approximately

For continuous thru-put and inventory data—W-C CONVEYOR-SCALE SYSTEMS

With a W-C Conveyor-Scale System incorporated in your process scheme, you can have up-to-minute thru-put data at any point from incoming transfer to inventory stock-pile. This data, expressed in terms of weight per unit of time, can be totalized for inventory records, process programming, or other manufacturing and accounting functions.

W-C Conveyor-Scale Systems can be supplied for flat or trough-type belts, fixed or variable speed, in capacities from 20 to 1000 tons per hour for new or existing conveyor installations. Each is a job engineered system employing standard, unitized components. As a result, you get a "custom" system at an "off-the-shelf" cost.

Typical applications include: Conveying and totalizing weight of ore from boat unloading stations; controlling feed and blending of materials to furnace.

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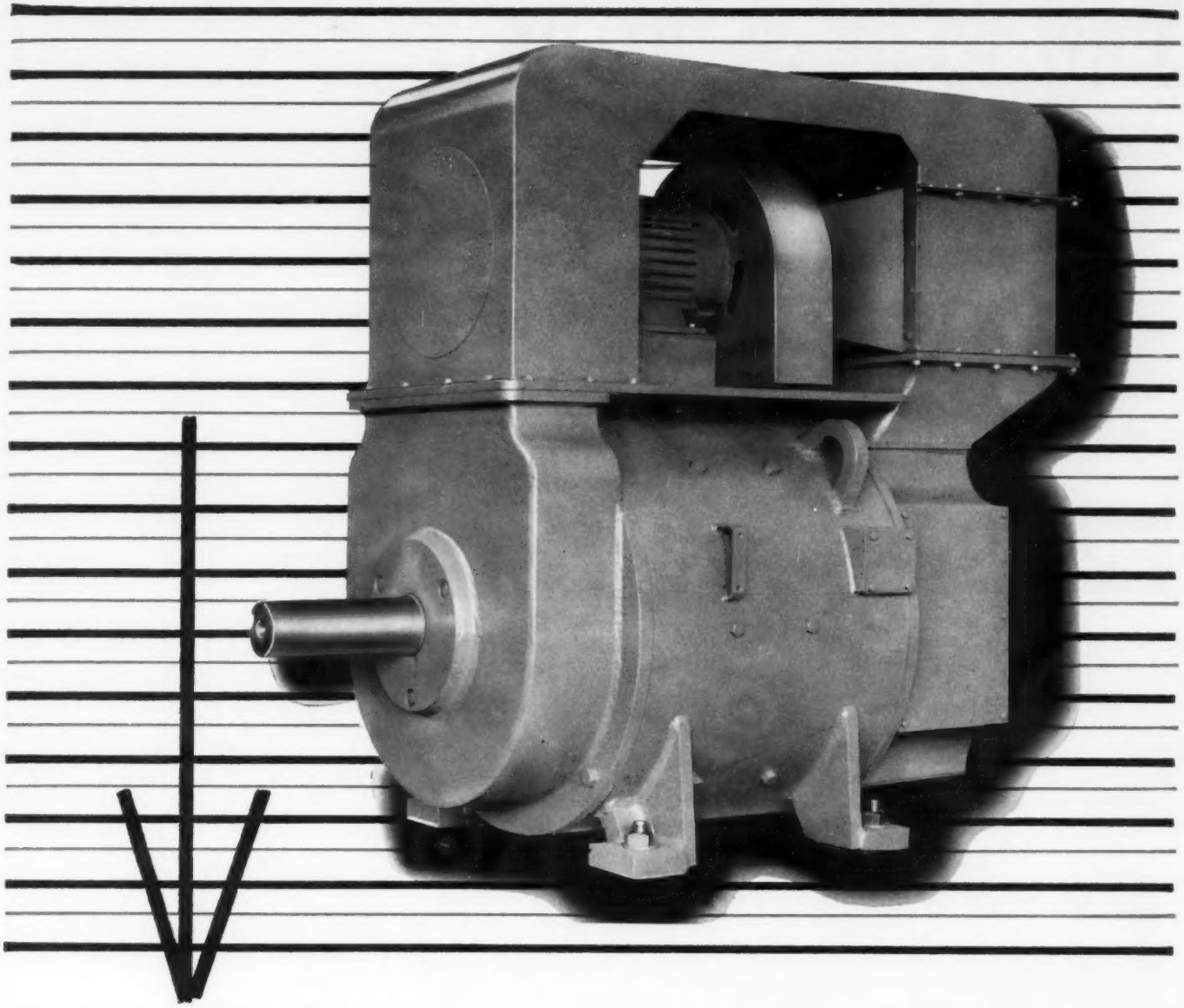

NEW

Totally Enclosed D-c. Motor for LOW SPEED Operating Conditions

Heavy overloads, wide range of operating speeds, dusty atmospheres; that's where the new Super 'T' Dual Cooled Motor stands out. It's an enclosed motor with better-than-open operating characteristics.

An independently powered fan pushes ventilating air through the motor and into a heat exchanger. A second fan blows cooling external air across the heat exchanger tubes. Constant ventilation is maintained without introducing outside air into the motor.

The Super 'T' Dual Cooled Motor will not overheat even at very low operating speeds. The independent fan motor maintains constant ventilation regardless of the Super 'T's operating speed.

Write today for more information on this new totally enclosed d-c. motor. Available 10 thru 200 hp. C-1605

Product of the combined resources of Reliance Electric and Engineering Company and its Master and Reeves Divisions

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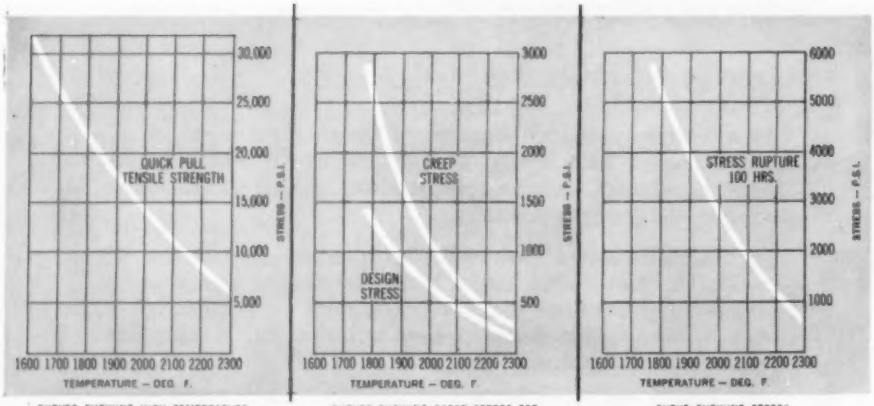
*Covered by U.S. Patents

casting alloy

Duraloy "HOM" is a special high nickel alloy developed to produce castings that meet high temperature requirements, especially when castings are subject to oxidizing atmospheres.



CURVES SHOWING HIGH TEMPERATURE SHORT-TIME TENSILE STRENGTH OF DURALOY-HOM

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2500 ft long by 150 to 500 ft wide, as compared with the Frood Pit which is 6300 ft long by 1400 ft wide.

Improved open pit mining methods and advances in metallurgical processes bring within economic range the use of low-grade ore such as will be produced from the new operation. The ore will be shipped to Inco's Copper Cliff Mill by rail.

INSTALL NEW VERTICAL HEAT TREAT FURNACES

△Installation of seven new vertical furnaces for heat treating electric-power generator rotors has been completed at the forging division of United States Steel Corp.'s Homestead District Works, it was announced by General Superintendent Robert A. McClure.

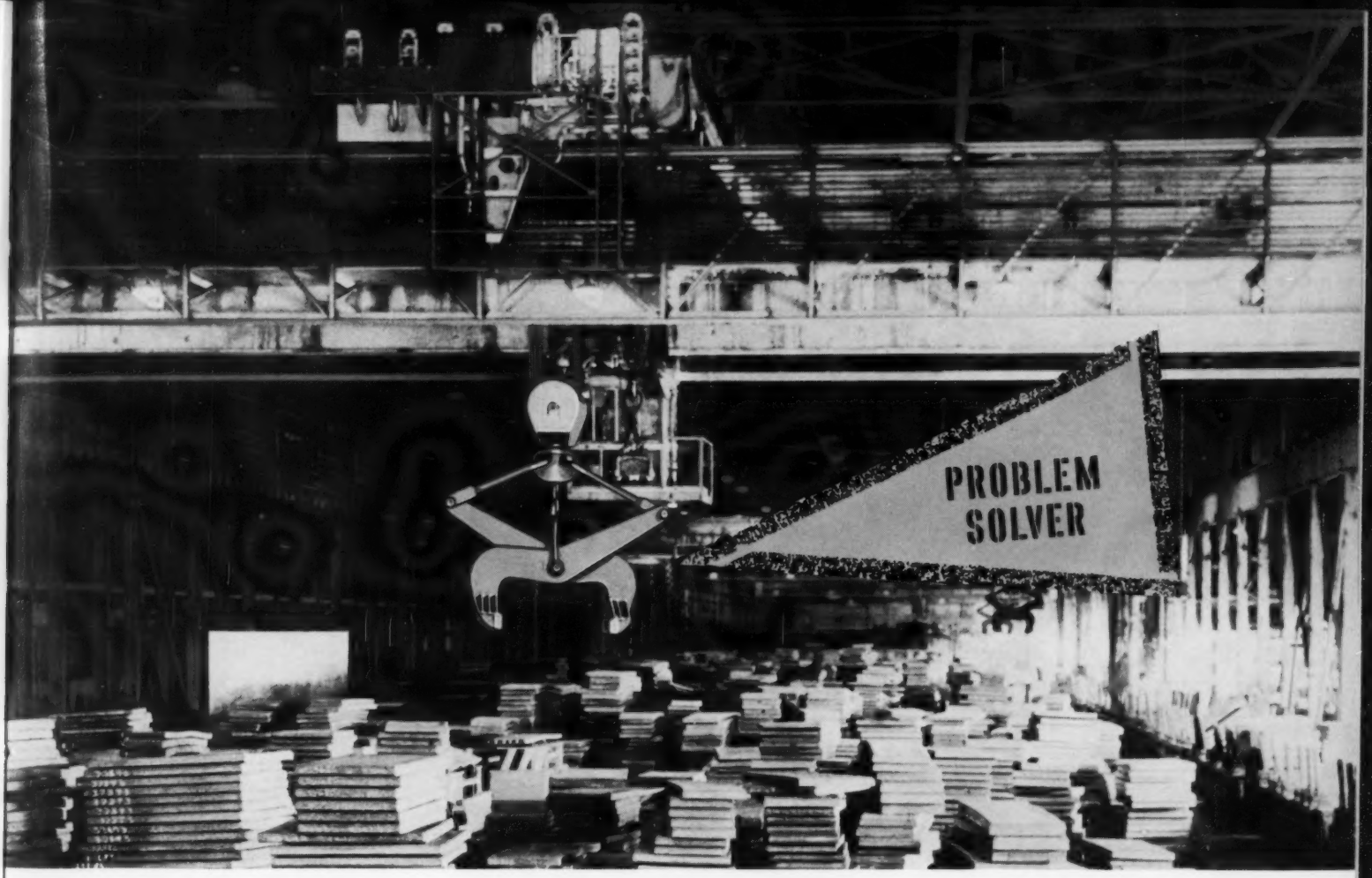
The new facilities, consisting of a quench tower and an upending cradle in addition to the seven new furnaces, were built primarily to satisfy customer demand for rotors heat-treated in an upright position after they have been forged and machined at the Homestead plant.

"The electrical industry," Mr. McClure said, "is working to improve its own products and has asked that more generator rotors be heat-treated vertically to eliminate any residual stresses which may occur in horizontal-furnace heat-treating."

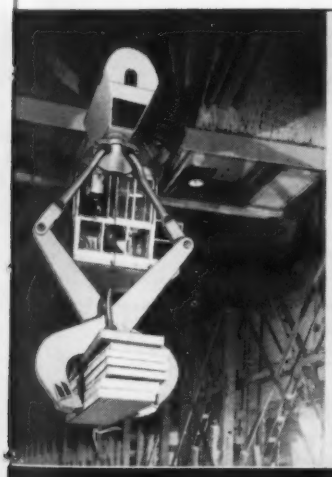
Until the new furnaces and auxiliary equipment were installed, Homestead Works operated only three vertical heat-treating furnaces and a quench tower in the No. 2 press shop of the forgings division.

Housed in a modern, spacious 100-ft-high building, the new furnaces burrow 35 ft below the concrete floor, rise 50 ft above it and can accommodate rotors and generators 40 ft in length and 60 in. in diameter. The older vertical furnaces imposed a 30-ft length restriction on all forgings.

An unusual part of the new units is the upending cradle. Developed exclusively by Homestead Works and being introduced for the first time in the vertical heating process, the cradle see-saws on an axis to raise the forging into position, protecting it in the process from being bent. An overhead crane can then lift the forging from the upender and carry it across to a waiting furnace.



TONGS put a tight grip on safety and economy



The tong jaws open to 76½ inches. They are operated by a separate hoisting unit with cable connected to the pivot point of the tongs.

The cab on these cranes is air-conditioned for operator comfort. It is supported from and travels with the trolley overhanging the rear girder.

Inland Steel Company gave up chains, spacers, and "hooker" manpower in piling slabs in No. 2 Slab Yard at East Chicago, Ill. Time proved the method unsafe for both "hooker" and crane, and inefficient as well. The chains often hung-up and had to be pulled free by the crane operator. Haphazard piling also robbed the yard of storage space.

Inland Steel's plant engineers and Shaw-Box engineers solved the problem. Now five "Shaw-Box" Cranes with unique tongs handle an average of 60,000 tons of slabs a week. They are 120-foot span cranes with 50 and 25 ton hooks, each with a lifting speed of 40 FPM. All slab piling is handled from the cab which travels with the trolley. Slabs are piled far neater than before, and many more can be stored in the same area.

Since their erection in 1957, all five cranes have proved their quality in dependable service. The same creative engineering has made great problem solvers of all types of Shaw-Box Cranes, whether built to AISE specs or individual standards of construction and performance. We welcome the opportunity to serve you.

MAXWELL MM MANNING & MOORE INC. TRADE MARK

60 K-1

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In Canada: Manning, Maxwell & Moore, Ltd., Galt, Ontario

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HYATT *HY-ROLL BEARINGS*

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Compare what the **PDQ WILL DO...**
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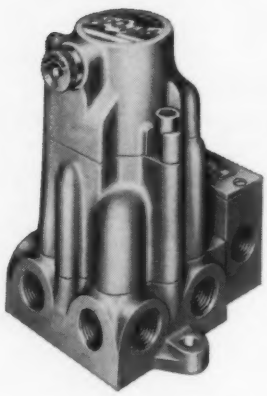
With any other air valve...



a ½" valve that will do a ¾" valve job at a ⅜" valve price

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What will the PDQ do? It will do a ¾" valve job. It has faster response time and greater capacity than valves twice its size and four times its weight. To repack you simply replace 2 self-contained units in less than a minute. You can change valves on the line in less than 30 seconds.

Will the PDQ last? The PDQ has a short stroke, and a light but rugged aluminum construction with built-in wear compensation. Anticipated valve life is conservatively estimated at 35 million cycles . . . on most applications this is **years** of trouble-free service. Coil (properly applied) is unconditionally guaranteed for the life of the valve.

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A. V. Ney, Sales Manager

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Your NATIONAL TRADE MARK brush man showed this electroplater how to double brush life!

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PROBLEM: Rapid brush wear was limiting generator performance.

RECOMMENDATION: "National" Brushes Grade BGX.

RESULTS: Not one commutator has been stoned or turned in five years. Brush wear has been even, with no selective action or overheating—even up to 20% overloads. Brush life has been doubled.

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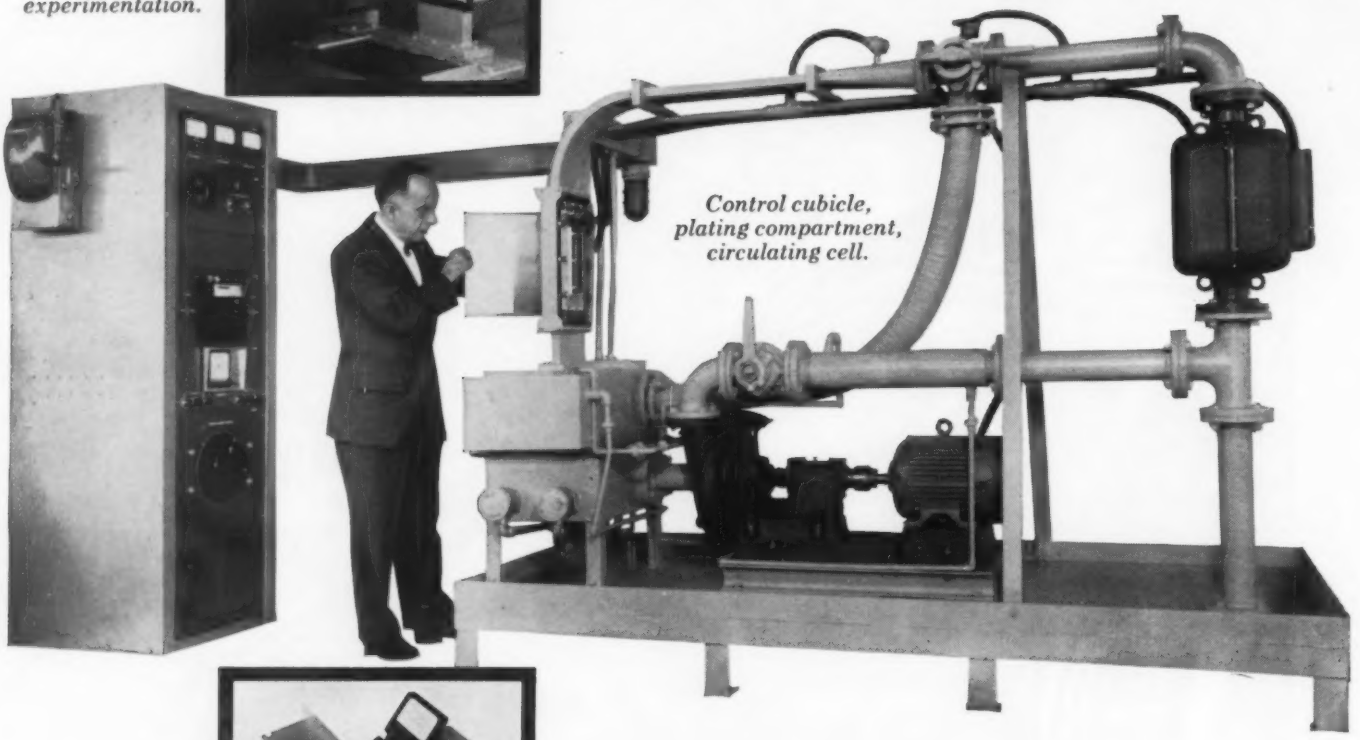
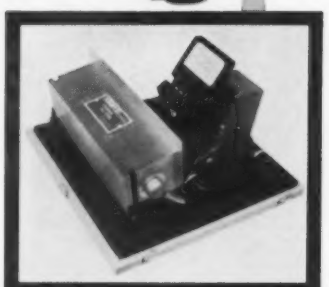
UNION CARBIDE

Plating compartment holds 6½" x 13¼" sample. Sample can also be fabricated into a container for further experimentation.

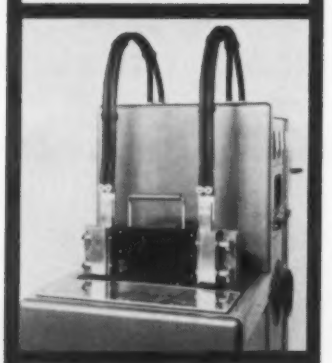
NEW SYSTEM CONCEPTS FOR STEEL



Control cubicle, plating compartment, circulating cell.



Brilliance comparator.



Conduction reflow unit.

Electrolytic Tinning Line Simulator

Constructed in modular form, DFI-Cleveland's Electrolytic Tinning Line Simulator represents a major improvement over previous systems.

In less than five minutes—including setup time—the following line parameters can be established:

1. Plate brilliance (comparative)
2. Current density (to 1000 amperes per square foot)
3. Electrolyte temperature
4. Line speed (to 750 feet per minute)

The system illustrates a unique method for simulating the dynamic conditions of a continuous electrolytic tinning line. Consider it as *one* example of DFI capabilities. We would be glad to tell you about the others. Write to William C. George, Manager, Department of Process Instrumentation and Controls.

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Designers for Industry Inc.

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POTS WITH A PURPOSE...

Cinder pots designed and produced at Mack-Hemp have one express function: to haul slag more safely and economically than any other pots. In most cases, Johnston Corrugated Cinder Pots with their expansible rims and other lasting features, will do the job best (more than 2600 are in use). In special cases, designs tailored to solve the specific problem are preferable. Remember, Mack-Hemp casts all kinds of pots and can supply them to your design and pattern. So if there's a lag in your slag handling, we'd be glad to show you how others have cut their cinder pot costs.

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BLAST FURNACE GAS WASHING

Chemico P-A Venturi washers selected for 36 installations at 20 separate plants...

In furnaces from coast to coast, the Chemico P-A Venturi washer is proving the single most economical and effective method of cleaning blast furnace gases. Prior to the introduction of the Venturi blast furnace washer, the dust content of the gas from conventional primary washers ranged from 0.15 to 0.35 grains/CF. The Venturi washer can achieve results as low as 0.005 grains/CF.

Low initial cost, inexpensive installation and virtually no maintenance are the more obvious economic advantages of Venturi blast furnace washers. In addition, however, Chemico Venturi washers require very little water—one-third as much as conventional washers—and permit complete recycle.

They are rugged units which have proved their reliability and long life in actual working furnaces. Also important is their ability to handle wide fluctuations in gas volume without sacrificing cleaning efficiency. With 36 units now in operation or on order, you can be certain of proven performance with a Chemico P-A Venturi washer.

If you are considering the installation of gas cleaning equipment in a blast furnace, a Chemico representative would be pleased to show you the kind of top-performance job you can expect from a Venturi washer. And remember, Chemico handles the complete job... PLANNING, DESIGN, ENGINEERING, ERECTION and START-UP.

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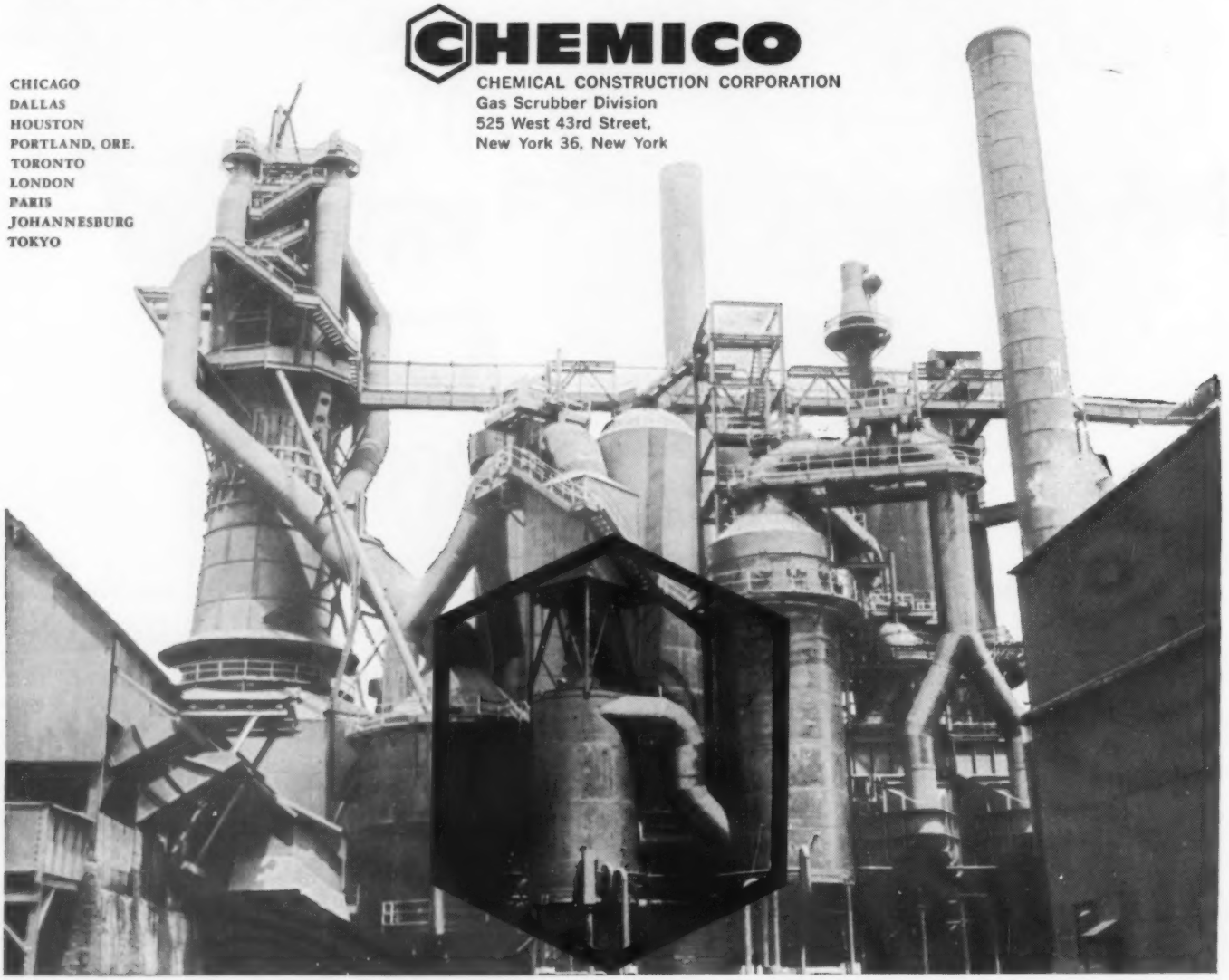


THE IDEAL COUPLER
FOR INDUSTRIAL HAULAGE

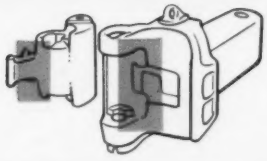
SHARON-10A

National's Sharon-10A Automatic Couplers are in use throughout the world on industrial cars, mine cars, railroad cars and transit cars. They can be furnished for varying service requirements such as regular top and bottom operation, improved type G side pull, type F side pull, rotary side or rotary bottom operation. For smaller cars not warranting use of the full-size Sharon-10A coupler, they can be furnished in 3/4 size as the Sharon-10 instead of with the full 10A contour.

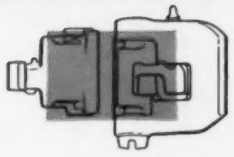
A-1255A

SHARON-10A • SHARON-10A • SHARON-10A

Gives longer service life. Liberal allowance for wear and distortion.

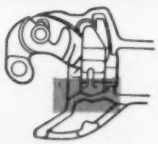


Has greater buffing strength. Substantial buffing shoulders in coupler head and knuckle.

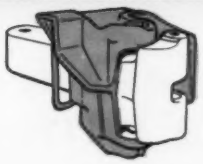


Has less pulling stress. Lugs reduce stresses on knuckle pin.

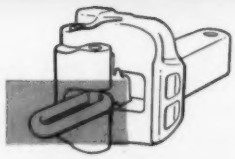
SHARON-10A • SHARON-10A • SHARON-10A



Features secure locking. V-shaped design stabilizes lock in coupler wall.



Is protected from molten metal. Hood protects uncoupling mechanism from metal splash.



Is versatile. Can be supplied with slotted or off-set knuckle for use with present link and pin equipment.

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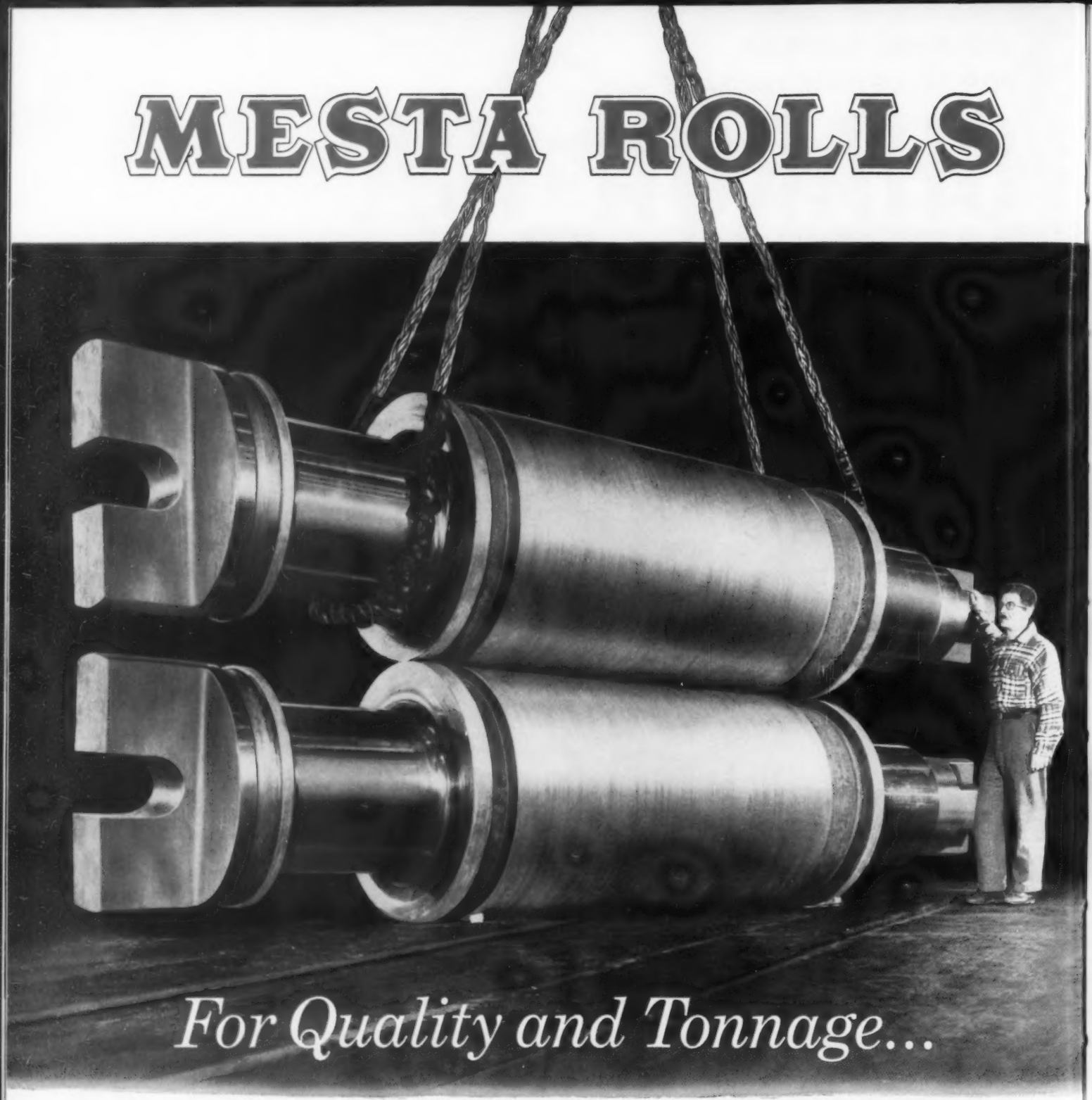

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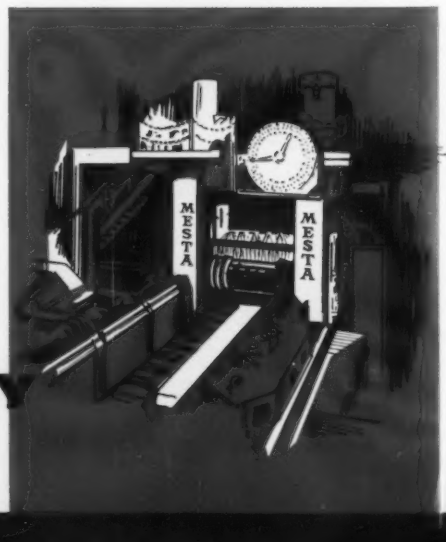

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Personnel News...

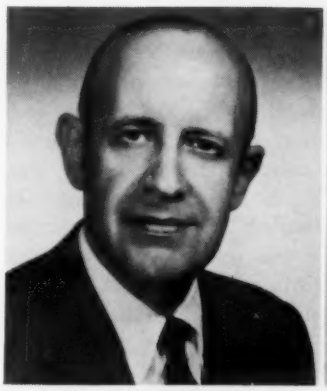
Albert J. Berdis, president of Weirton Steel Co., Division of National Steel Corp., was named chairman of its board of directors, succeeding **Edwin O. Burgham** who has retired from active service. Mr. Burgham will continue as a full time consultant to the officers of the company. The new president and chief executive officer of Weirton Steel is **Charles G. Tournay** who was formerly assistant to the president of National Steel Corp.

Mr. Berdis joined United States Steel Corp. as an electrical engineer in 1935, and continued in the employ of U. S. Steel for the next 21 years during which he carried out a variety of engineering, operating and administrative assignments. In 1956, Mr. Berdis became vice president in charge of manufacturing for the Aluminum Division of Olin Mathieson Corp. from which he resigned in 1958 to become president of Weirton Steel. Early in 1959, Mr. Berdis was given the additional duties of president of Midwest Steel Corp. and has been in general charge of the plant's construction and development of its organization.

Mr. Tournay advances to president of Weirton Steel following a career of 34 years at Weirton, Great Lakes and National Steel. He advanced through a number of positions to assistant to the general superintendent at Weirton in 1941. In 1956, he was named assistant to the president and later in the same year was transferred to Great Lakes Steel Corp. where he was elected vice president. In 1958, Mr. Tournay came to the Pittsburgh headquarters of National Steel in his most recent capacity as assistant to the president.

A. J. BERDIS

C. G. TOURNAY



C. M. BEEGHLY

A. B. VESTAL

E. R. JOHNSON

H. L. ALLEN

Charles M. Beeghly has been elected president of Jones & Laughlin Steel Corp. Mr. Beeghly has served as executive vice president since 1958, and as a director of the corporation since 1957. **Avery C. Adams,** who has served as chairman and president, will continue as chairman and chief executive officer. Mr. Beeghly was president of the J&L Strip Steel Division with headquarters in Youngstown, Ohio, until elected executive vice president of the corporation.

A. B. Vestal has been appointed assistant director—capital expenditure budget control for Jones & Laughlin Steel Corp. He formerly was planning engineer, Plant Development Division. Employed by J&L from 1937 to 1940 as a Steam Engineer, Mr. Vestal subsequently spent a number of years in the steel industry in both industrial engineering and management consulting. He returned to J&L in 1954, as supervisor, planning and operations analysis.

Ernest R. Johnson has been elected to assistant president and first vice president of Republic Steel Corp., and **Harry L. Allen** was elected to vice president in charge of operations. Mr. Johnson, who has been vice president in charge of operations for the company since 1954, will be the third ranking officer of the corporation. In his new position, he will have general supervision of officials in charge of the operating, research, order, traffic and claim departments of Republic. He began his steel career in 1922 when he joined the Central Steel Co., Republic's predecessor in Massillon, Ohio. After working on various mill jobs for three years, he joined the company's metallurgical staff and subsequently was named assistant superintendent of the metallurgical laboratory and assistant chief metallurgical engineer in 1929. In 1944, Mr. Johnson was appointed chief metallurgical engineer for Republic's Central Alloy Steel. He was named assistant district manager two years later and district

C. W. CRAVENS

R. P. CARPENTER

E. A. MARCH

L. HOWELL

manager in 1952. In 1953, Mr. Johnson was promoted and transferred from Massillon to Republic's General Offices in Cleveland as assistant vice president in charge of operations with jurisdiction over the company's eight basic steel plants. In 1954, he was elected vice president in charge of operations. Mr. Allen, who succeeds Mr. Johnson as vice president in charge of operations, has been with Republic for 27 years. He joined the Corrigan-McKinney Steel Co. in Cleveland in 1933. He continued with Republic after the two companies merged in 1935 and the Corrigan facilities then became Republic operations. In 1947, he was transferred to Buffalo, N. Y., as assistant manager of Republic's Buffalo Steel District. He was appointed district manager in 1952. He was named assistant vice president in charge of operations in 1954, at which time he was transferred into Republic's Cleveland General Offices.

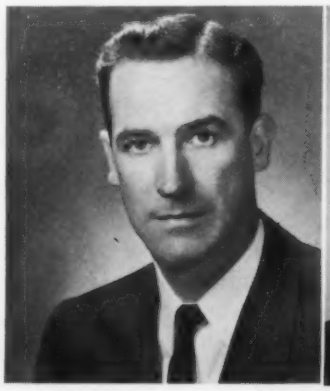
Charles W. Cravens succeeds Mr. Allen as assistant vice president in charge of steel plant operations, and **Robert P. Carpenter,** becomes manager of the Cleveland District, succeeding Mr. Cravens. Mr. Cravens joined Republic in 1933 as a sales engineer in the Alloy Sales Division in Canton, Ohio. He was transferred into the Central Alloy District's Operating Department in 1940. Two years later, he moved to Chicago as a senior melter at Republic's South Chicago steel plant. In 1945, he was appointed assistant superintendent of the plant's No. 1 open hearth shop and in 1947 he was named assistant superintendent of the Tilting and Electric Furnace Department. Mr. Cravens was promoted and transferred to the company's Cleveland plant in 1953 as superintendent of the No. 2 open hearth shop. He subsequently was named second assistant district manager in 1954, assistant district manager in 1956 and manager of the Cleveland District last year. Mr. Carpenter joined Republic in 1940 as a third helper on open hearth furnaces at the company's Warren, Ohio, steel plant. He was transferred to the Central Alloy District's Canton steel plant in 1942, and after progressing to first helper on electric furnaces, was appointed assistant superintendent of the Open Hearth Department at the Massillon, Ohio, steel plant in 1944 and superintendent in 1946. He was transferred to Cleveland to direct open hearth operations there in 1948 and was named superintendent of Republic's Massillon plant in 1953. He has been manager of the Buffalo District since 1957.

Eugene A. March, formerly assistant works manager at the Crucible Steel Co.'s Midland plant, has been appointed the company's director of metallurgy. He succeeds **E. T. Walton** who has retired. **Lawton Howell** succeeds Mr. March as assistant works manager at Midland. Mr. March joined Crucible in 1946 as metallurgist—mill control at the company's Sanderson-Halcomb Works in Syracuse, N. Y. He became foreman of the rolling mill in 1948 and in 1950, metallurgist—Melting Department. He was named general supervisor of metallurgical control two years later, chief works metallurgist in 1953, and assistant works manager in 1957. Mr. March was transferred to Midland in 1958 as chief metallurgist and last year was appointed assistant works manager. Mr. Howell joined Crucible in 1945 at Midland Works.

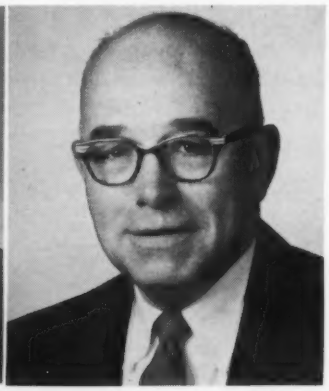
William R. Roesch has been appointed assistant to the vice president—Engineering and plant for Jones & Laughlin Steel Corp. Mr. Roesch, who was superintendent of the General Maintenance Department at J&L's Cleveland Works will have his headquarters in J&L's general office, Pittsburgh. A J&L employee since 1946, Mr. Roesch was named to J&L's general office as a construction engineer in 1950. He was appointed plant engineer and maintenance supervisor at the Electricweld Tube Division in Oil City, Pa., in 1951, and became general plant foreman there in 1954. He was named assistant superintendent of maintenance at Cleveland in 1955, and was appointed superintendent of maintenance in 1958.

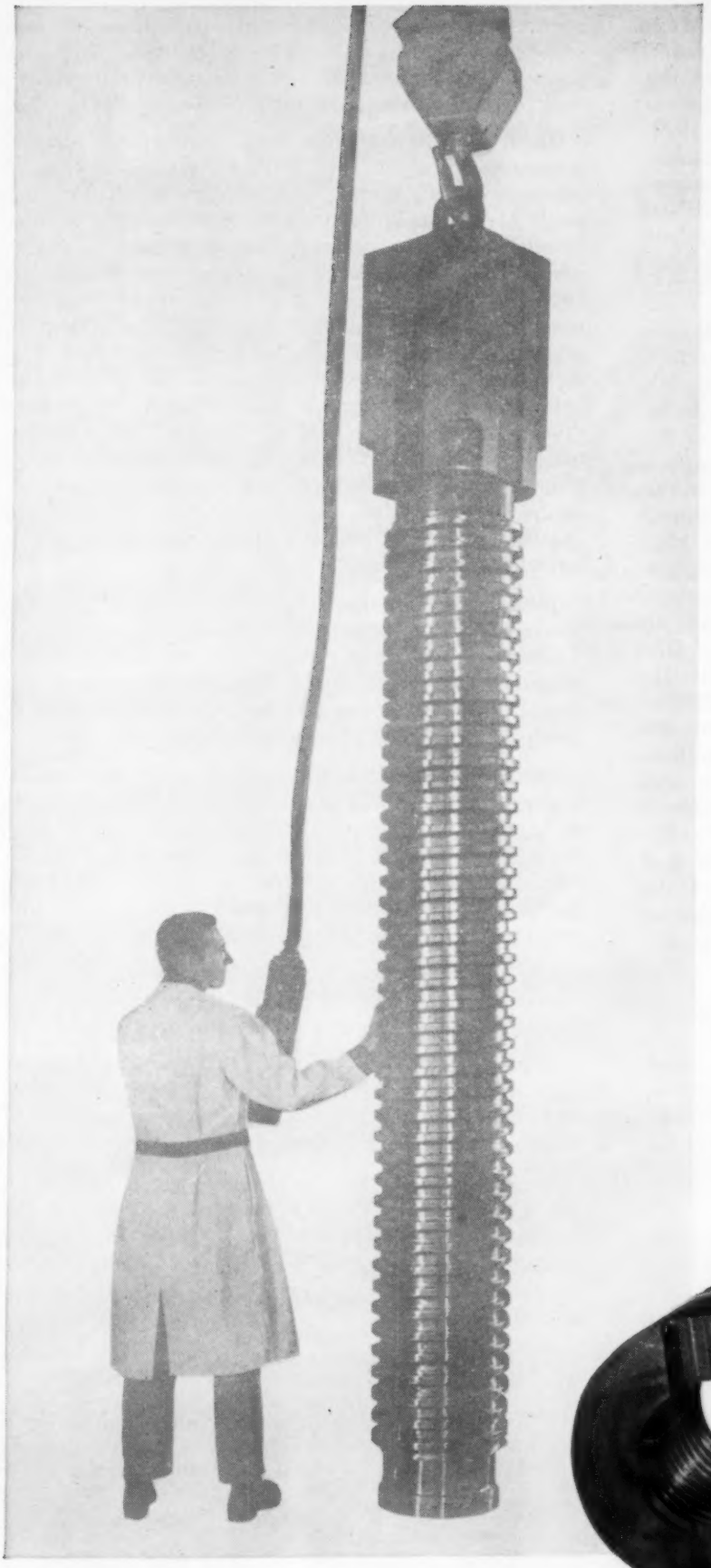
Marshall W. Davies succeeds Mr. Roesch as superintendent of the Maintenance Department. He was formerly general maintenance foreman, South Mills,

W. R. ROESCH



M. W. DAVIES





Over 14,000,000 tons of steel with one screw, one B-L-H housing nut!

Quite literally, this combination has proved unbeatable: a Tool Steel Gear and Pinion screwdown screw and a B-L-H bronze housing nut. These two were critical components in production of more than 14,000,000 tons of steel on a 46-in. blooming mill.

The ability to withstand for record-breaking periods the terrific shock inherent in blooming mill operation is convincing evidence of the excellence of B-L-H nonferrous castings. Whatever your own requirements—job shop or high-production foundry work, castings of many alloys, and weighing from a few ounces to 100,000 lb.—you can be confident that B-L-H castings will more than fill the bill. Write us for a copy of our illustrated Foundry Bulletin 6002.

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Industrial Equipment Division · Philadelphia 42, Pa.

at J&L's Aliquippa Works. Mr. Davies has been a J&L employee at the Aliquippa Works for almost 33 years. He started as a general maintenance foreman at the Blast Furnace Department in 1926, and became assistant master mechanic of the department in 1929. He was named maintenance foreman at the Seamless Tube Department in 1941, and became general maintenance foreman for the Seamless and Welded Tube Departments in 1946. He was appointed superintendent of the Seamless Tube Department in 1947, and became general maintenance foreman—South Mills in 1955.

Emil W. Carlson has been named manager of Republic Steel Corp.'s Buffalo district succeeding **Robert P. Carpenter,** who was named manager of Republic's Cleveland district. Also announced was the appointment of **Leo R. Silliman** to assistant manager of the Buffalo District succeeding Mr. Carlson. Mr. Carlson started with Republic in 1939 as a machinist at the company's Chicago district steel plant. He was named mechanical foreman of the plant's bar mills in 1947 and was appointed assistant superintendent of maintenance there three years later. He became assistant superintendent of the Chicago plant's bar mills in 1950 and was transferred to Republic's Cleveland District plant in 1955 as superintendent of bar mills. He has been assistant manager of the Buffalo District since 1957. Mr. Silliman has been with Republic in the Buffalo district since joining the company in 1935. He started in the plant's Metallurgical Department and was named chief metallurgical clerk in 1942 and open hearth metallurgist two years later. In 1948, he was appointed superintendent of steel conservation, and he was promoted to assistant superintendent of the finishing departments in 1954. He has been superintendent of steel conditioning and finishing departments since last November.

I. G. Orellana was appointed to head the Measurement and Control Division of Republic Steel Corp.'s Electromechanical Research Center in Cleveland, Ohio. A veteran of 19 years of service with Republic, Mr. Orellana joined the company in 1941 as a research engineer in the Electrical Laboratory in Cleveland. Since 1948, he has been project engineer at the Electrical Laboratory.

Lawrence G. Maechtlen has been elected president of Square D Co. He has been associated with Square D for 34 years, joining the company in 1926. In 1951, he was elected a vice president and director while continuing to head the western operations. He was transferred to corporate offices in Detroit, Mich., as first vice president in 1957, and was named to the newly-created post of executive vice president in 1958.

Ralph P. Kimmel has been appointed assistant general superintendent of United States Steel Corp.'s Johnstown, Pa., Works, and **William N. Pauley** succeeds Mr. Kimmel as division superintendent of the foundries. Mr. Kimmel who succeeds **Willard U. Taylor** joined U. S. Steel in 1935 at Johnstown Works. In 1940, he was named chemist and later appointed to the position of metallurgist. Subsequently he served as assistant to the chief metallurgist, assistant chief metallurgist and chief metallurgist, the position he held between 1951 and 1956 when he was appointed division superintendent of the foundry. Mr. Pauley came to Johnstown in 1953 as plant industrial engineer after serving U. S. Steel in various supervisory capacities at the Ohio and McDonald Works in the Youngstown District. Since 1958 he has held the position of superintendent of industrial relations.

John G. Gill has been appointed assistant director—process development in Crucible Steel Co. of America's Technology Department. Mr. Gill was formerly vice president and director with Canadian Steel Improvements, Ltd. Previously he worked for United Steel Companies, Sheffield, England.

Bernard W. Bernstrom, formerly chief mechanical engineer for Pickands, Mather & Co., has joined Jones & Laughlin Steel Corp.'s Engineering Department in the Raw Materials Division. In his new position as Raw Materials Engineer, he will be responsible for the coordination of engineering policies, procedures and standards related to J&L's mining activities.

Louis Polk, Jr., has been appointed vice president of operations, The Sheffield Corp. He was formerly assistant vice president and manager of operations.

E. Allan Hoppenstedt has been appointed sales manager of the International Division of Hewitt-Robins Inc. Mr. Hoppenstedt was formerly manager of the International Division of Fischer and Porter Co.

Donald H. Beitel has been named superintendent of the coke plant at Pittsburgh Coke & Chemical Co. At the same time **James W. McEwen** was named assistant superintendent of the coke plant and **Walter C. Littlecott,** general foreman for by-products and benzol.

E. W. CARLSON

L. R. SILLIMAN

I. G. ORELLANA

L. G. MAECHTLEN

STEEL MILL CUTS REGRINDING TIME IN HALF WITH MIDVAC

Micro Lustre

VACUUM MELTED FINISHING ROLLS

A switch from air-melted rolls to MidVac Rolls reduced regrinding and refinishing time by as much as 50% in one large steel mill. Now, operators can refinish rolls quicker to a higher polish which produces finer sheets.

MidVac Rolls are made with consumable electrode vacuum melted MidVac Steels. These super-alloy steels produce a Micro-Lustre finish made possible by super uniformity of fine grain structure, maximum freedom of defects and non-metallic inclusions. MidVac Micro-Lustre Rolls assure rolling free from surface imperfections . . . quicker regrinding . . . and give longer trouble-free service between grinds.

MidVac Rolls are being used throughout the nation for rolling stainless steel, aluminum, foil, brass and precious metals. Midvale-Heppenstall also make forged rolls of any size, for any purpose required in the rolling of steel, aluminum, copper, brass and other metals . . . as well as paper, plastics and rubber. Write for complete data on these new Micro-Lustre Rolls.

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TASIL Special Refractory CEMENTS

The Chas. Taylor Sons Co., pioneer developer of high-grade Sillimanite cements in the United States, now offers you new TASIL (Taylor Sillimanite) special refractory heat-setting and air-setting cements which have been **even further improved!**

Formulated in the Chas. Taylor Research and Development Laboratory, and performance-proved in the field, these superior Sillimanite cements provide:

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Use improved TASIL cements for bonding Sillimanite or mullite, high alumina, kaolin-type, and super-duty brick and shapes in any high temperature furnace. Also excellent as a protective coating on walls and arches built of insulating brick. Order new TASIL cements for your next re-build for positive protection of the joints in your furnace linings. Write direct, or call in the Taylor field engineer in your district for full details.

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K. R. KNOBLAUCH (left)
C. J. MOORE (center)
W. F. OLEKSIAK (right)

Mr. Beitel, who started with the company in 1935, had previously been assistant superintendent. He began as a helper at the benzol plant and in 1942 was named as foreman of the by-product and benzol operations. Mr. McEwen started with Pittsburgh Coke in 1939. Mr. Littlecott joined the company in 1940.

K. Russell Knoblauch was appointed market sales manager for the Industrial Products Group, Minneapolis-Honeywell Regulator Co. Mr. Knoblauch, a veteran of 36 years of service in the Honeywell sales organization, will have supervisory responsibility over managers for nearly a dozen markets in which sales of industrial products are alined.

C. J. Moore, former general sales and marketing manager of Exide Industrial Division, The Electric Storage Battery Co., has been promoted to vice president—marketing of the division. Joining Exide in 1935, Mr. Moore began as a salesman in the Pittsburgh branch. In 1941, he was transferred to company headquarters as supervisor of motive power sales. He returned to Pittsburgh in 1946 as assistant branch manager and became branch manager there in 1947. He again was transferred to Philadelphia in 1949 as manager of the railway and motive power sales division and has been successively promoted to sales manager and general sales and marketing manager.

Walter F. Oleksiak has been elected to the newly created post of vice president—construction of United Engineers & Constructors Inc. Mr. Oleksiak has been with United Engineers since 1941 when he joined the firm as a field engineer. Since then he has held various construction posts including that of construction manager to which he was named in 1958. At the same time, **Thomas M. Dahl** was named manager of the company's Chicago

EXECUTIVE REPORT #9

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Blast Cleaning Structural Steel Provides Big Savings

Prominent structural steel fabricating plants now blast clean all shapes and sizes of structural steel channels, angles, plates, bar and rod stock—in Wheelabrator cabinets.

The straight-line production made possible by Wheelabrator airless blast cleaning has improved manufacturing efficiency and reduced their cleaning costs substantially. And the shot-blasted finish has proven to be ideal for lasting surface protection of the finished structural members.

Wheelabrator's unequaled experience in descaling structural steel is at your service. Send for new informative bulletin No. 152-D. Write to Wheelabrator Corp., 396 S. Byrkit Street, Mishawaka, Ind. In Canada, P. O. Box 490 Scarborough, Ont.

WHEELABRATOR
AIRLESS BLAST EQUIPMENT

office. Formerly new business representative in the firm's midwest region, Mr. Dahl, in his new post, will continue to have offices in Chicago and will be responsible for new business activity in the states of Ohio, Kentucky, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa and Missouri. He joined United Engineers in 1946 and held posts of supervising designer, electrical engineer and supervising engineer before being named new business representative in 1958.

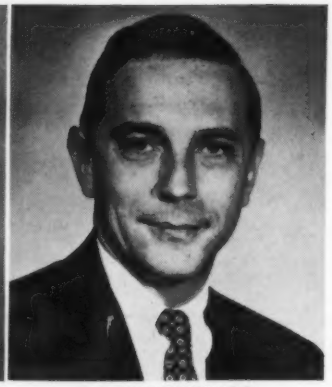
Robert O. Bullard has been elected vice president and general manager of the Electronics and Instrumentation Division, Baldwin-Lima-Hamilton Corp. Mr. Bullard was formerly general manager of the Power Tube Department of the General Electric Co.

John H. Tinnemeyer, Jr., has been named superintendent of blast furnaces at the Neville Island plant of Pittsburgh Coke & Chemical Co. Prior to his new appointment he had been assistant superintendent. Mr. Tinnemeyer has been employed by Pittsburgh Coke & Chemical Co. since 1933 and has served in several capacities with the Coke and Iron Division.

R. G. Hammer has been appointed sales manager—Western Division of Refractory & Insulation Corp. He was formerly assistant sales manager and has been with the company since 1939.

James R. Dickey has been appointed general maintenance foreman, South Mills, at Aliquippa, succeeding Mr. Davies. Mr. Dickey, formerly was general foreman, electrolytic tinning in the Works Tin Plate Department. A J&L employee since 1951, Mr. Dickey started in the blooming mill. He was appointed an operating engineer in the General Maintenance Department in 1952, and became assistant general foreman of electrolytic tinning in the Tin Plate Department in 1955.

J. E. BAXTER



J. A. BAUSCHER

J. Edward Baxter has been appointed manager of steel plant sales for the National Alloy Division of Blaw-Knox Co. Mr. Baxter has been with the division as a sales engineer for the last six years. Previously he was associated with Jones & Laughlin Steel Corp. for 17 years.

J. A. Bauscher has joined the Lee Wilson Engineering Co., Inc., as vice president in charge of research. Mr. Bauscher comes to Lee Wilson from U. S. Steel Corp. where he was chief of the Sheet Products Division of the Applied Research Laboratory.

James P. Kneubuhl has been elected president of Research-Cottrell, Inc., succeeding **William Hinkley,** who will continue as chairman of the board. Mr.

EXECUTIVE REPORT #12

A PIPE DREAM COMES TRUE

Wheelabrator® cleans skelp edges at new low cost

Another example of steel industry savings made possible by Wheelabrator mechanical descaling is the exceptional economy realized by pipe rolling mills in cleaning of skelp. Here it is desired to clean only a small strip along both edges of the bottom side of the skelp, which will be butted together and electro-welded.

In the Wheelabrator process, two blasting wheels are positioned to pinpoint their abrasive barrage along the edges, giving fast, thorough cleaning of these surfaces only.

Wheelabrator leads in mechanizing steel mill descaling methods

In over 100 installations in all types of steel mill applications, Wheelabrator has proven its cost-saving benefits. For engineering consultation call or write Wheelabrator Corporation, 396 S. Byrkit St., Mishawaka, Indiana. In Canada, P. O. Box 490, Scarborough, Ontario.

Kneubuhl comes to Research-Cottrell from The Fluor Corp., Ltd., where he was vice president in charge of utility and government sales.

George M. Rust was elected as an executive vice president, and **J. Bolling Sullivan, Jr.,** and **John W. Clark** were made vice presidents of The Rust Engineering Co.

David W. Telfer has been made processing assistant, bar and wire finishing sections, Baltimore Works, Armco Steel Corp. **Joseph E. Smith, Jr.,** will succeed Mr. Telfer as superintendent of the Wire Finishing Department. Mr. Telfer joined Armco at the Baltimore Works in 1934. He was made a foreman in 1936, and wire mill supervisor in 1941. He became superintendent of the wire mill and strip mill in 1945, and superintendent of the Wire Finishing Department in 1954. Mr. Smith started his career with Armco in 1931 at Baltimore.

John C. Udd, who has been president of Strategic Materials Corp. since its inception in 1951, has been elected chairman of the board of directors. **Frank W. Chambers,** formerly executive vice president, has been elected president. **Samuel D. Lunt,** who had been chairman of the board for several years, continues as a director and member of the executive committee.

Obituaries

Earle C. Smith, 69, chief metallurgist and director of research for Republic Steel Corp. died May 20. Mr. Smith became affiliated with Republic in 1917, when he was employed in a civilian capacity by the United States Army Signal Corps, and was assigned to Massillon, Ohio, to work with the Central Steel Co., now a part of Republic, in connection with special steels for the aircraft industry. As a result of his work in this capacity, he was employed after the war as chief inspector for Central Steel, beginning employment with Republic Steel through a predecessor company that has extended over 41 years. He became chief metallurgist of Central Steel, and when this organization was later merged with United Alloy Steel Co. of Canton, Ohio, Mr. Smith served as assistant superintendent of the merged companies. Following the merger which formed Republic Steel Corp. in 1930, he served as assistant district manager for the Republic plants in Canton-Massillon. Mr. Smith was appointed chief metallurgist for Republic in 1932 and had been director of research since 1956.

Call or Write STAMCO for...

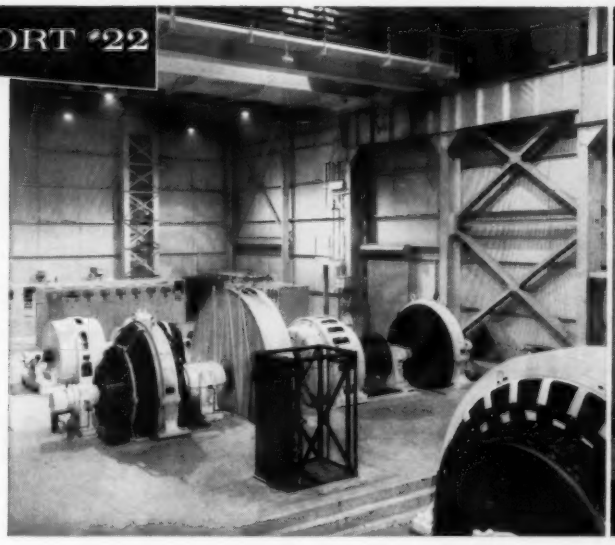
Slitting and Coiling Lines
Cut-to-Length Lines
Flying Shear Lines
Power Squaring Shears • Automatic Re-squaring • Corrugating
Culvert • Steel Mill Equipment

STAMCO, Inc., New Bremen, Ohio

EXECUTIVE REPORT '22

NO ROOM FOR DUST

In Acme Steel's New Blooming Mill Motor Room



Even the air you breathe isn't pure enough to meet the demands for air to ventilate the motors and generators in Acme Steel Company's new Riverdale, Ill. plant. Wheelabrator Ultra-Filtration® provides air that is ultra-pure for the exacting requirement of their blooming mill motor and control room. Furnishing 135,000 cfm of super-filtered air, this installation has been functioning with absolutely no maintenance, and no filter change since its installation in 1959.

FILTRATION EFFICIENCES OF 99.9% ARE FREQUENTLY ACHIEVED BY WHEELABRATOR

Ultra-Filtration equipment provides filtration efficiencies of above 99%, measured both by weight and discoloration. For details of this economical air filtering equipment write to Wheelabrator Corp., 396 S. Byrkit St., Mishawaka, Ind. In Canada, P. O. Box 490, Scarborough, Ont.

WHEELABRATOR
DUST AND FUME CONTROL

NOW...full-time analysis of materials in actual production

XEG X-Ray Emission Gage watches and measures up to 5 selected elements

Solids, powders, slurries, fluids — General Electric XEG X-Ray Emission Gage examines them as they actually move through production . . . writes a running record of their elemental make-up. XEG tirelessly surveys up to five elements simultaneously, continuously . . . senses both their *presence* and *quantity*. Where practical to operate minus reference, even analyzes a sixth element.

Versatile XEG serves equally well for on-line process control or individual-sample analysis. Scientifically trained operator is not required — because once set for specific analysis, there's little need for further adjustment. XEG then automatically delivers the facts on composition for rapid-fire, continuous feedback to process control.

Applications are as limitless as your imagination. And, whenever you like, we can explore XEG potentials with you. The details are available now from your G-E x-ray representative. Or write us at General Electric Company, X-Ray Department, Milwaukee 1, Wisconsin, for Pub. IS-64

Progress Is Our Most Important Product

GENERAL ELECTRIC

Photo Courtesy Ray Mines Division, Kennecott Copper Corporation

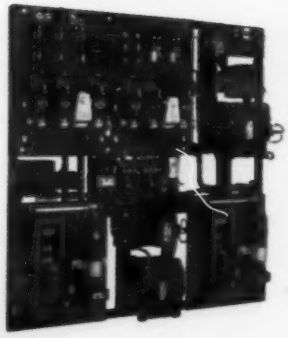
FOR EVERY APPLICATION, THERE'S ONE CRANE OUTSTANDING...

IN COPPER SMELTERS: Fast, safe, precision control is essential in a converter aisle like this. This 60-ton P&H crane is equipped with the finest a-c crane control yet designed — P&H Electronic Stepless Control and Magnetorque electro-magnetic braking.

Here, as in every P&H crane installation, P&H engineers have taken all factors affecting performance into consideration. Exact requirements of this converter-aisle installation have been carefully integrated into the overall design.

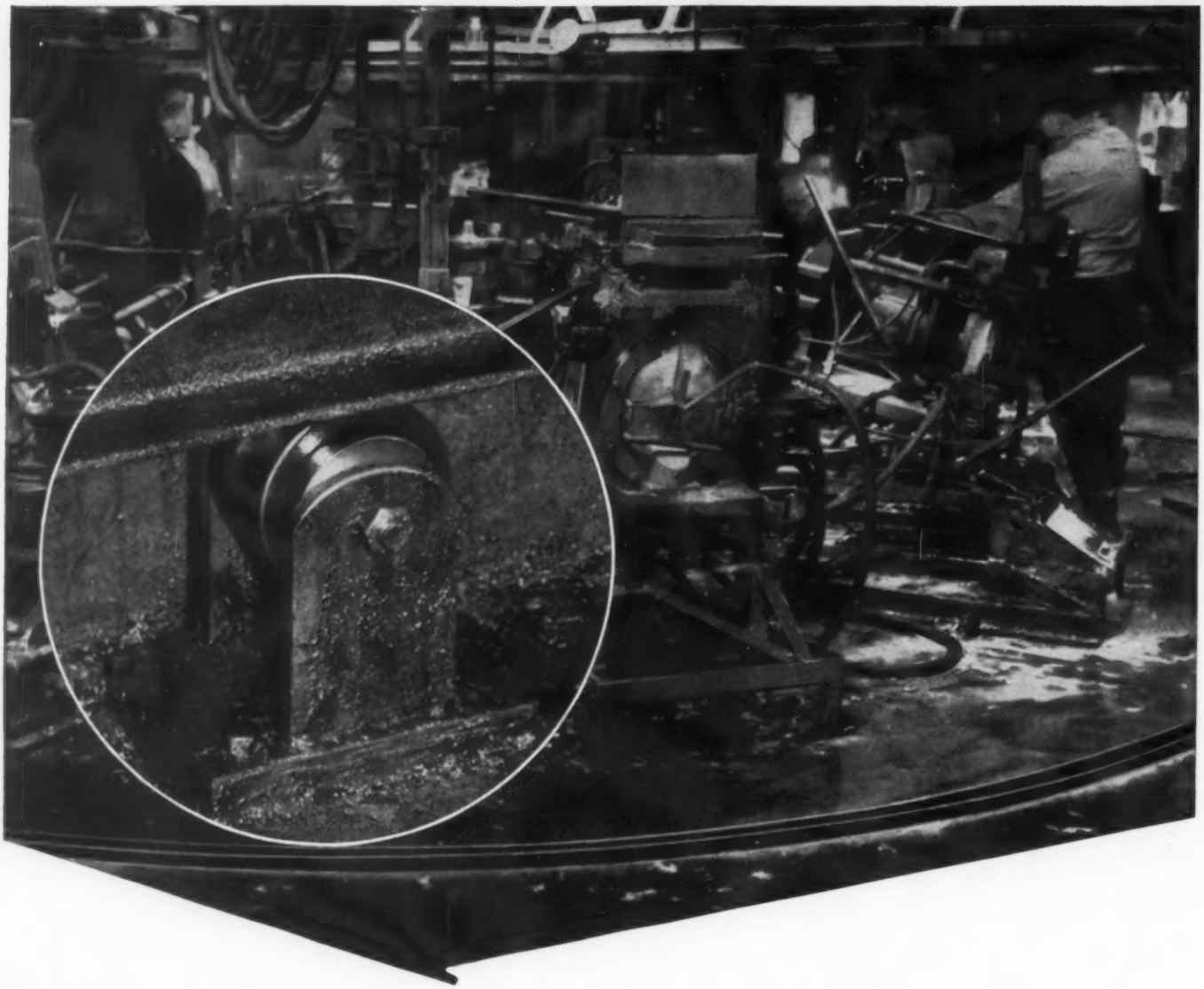
If this kind of custom engineering makes sense to you for your operation, why not send for more information? Write for bulletin C-42, Dept. 118, Harnischfeger Corporation, Milwaukee 46, Wis.

Heart of the P&H Electronic Stepless Control is this a-c electronic hoisting-lowering control panel. With this modern electronic control on a three-motor crane, as many as 244 electrical contacts are eliminated. Speed-load characteristics of Electronic Stepless Control far exceed any other conventional a-c or d-c controlled crane!



P&H
OVERHEAD CRANES

HARNISCHFEGER
Milwaukee 46, Wisconsin



Bearings, Inc. turned this turntable from a costly maintenance problem into a smooth, trouble-free operation!

Our customer, an aluminum foundry, designed and built this system for continuous and automatic pouring of permanent mold castings. The turntable is approximately 20 feet in diameter. Supporting the table, which weighs several tons, were 20 large, double-row bearings. The life of these bearings was only a few weeks and their cost, plus downtime, was becoming increasingly expensive.

Our bearing engineers were asked for a solution and, after an investigation, recommended a camroll bearing. Now, after many months of operation, all turntables in the plant are equipped with the bearings we recommended and there has not been a bearing failure in that period!

If you have a problem involving bearings, call the Bearings, Inc. branch nearest you for expert help. We are the authorized distributor for all the bearings we sell —your guarantee that the bearings we deliver will be of the latest manufacture and right for your application!

Providing bearing service in the North ➤ **BEARINGS, INC.**

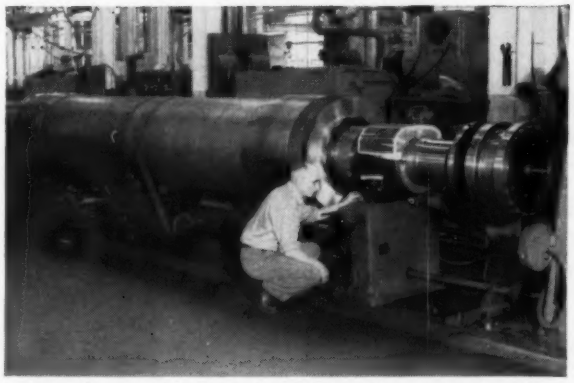
OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Lockland • Mansfield • Painesville • Toledo • Youngstown Zanesville • **INDIANA:** Ft. Wayne • Indianapolis • Muncie • Terre Haute • **PENNSYLVANIA:** Erie • Johnstown • Philadelphia • Pittsburgh • York **WEST VIRGINIA:** Charleston • Huntington • Parkersburg • Wheeling • **NEW JERSEY:** Camden • Newark **NEW YORK:** Balanrol Corp., Buffalo • Niagara Falls • **MARYLAND:** Baltimore • **DELAWARE:** Wilmington

and

in the South ➤ **DIXIE BEARINGS, INC.**

FLORIDA: Jacksonville • **GEORGIA:** Atlanta • **KENTUCKY:** Louisville • **LOUISIANA:** Baton Rouge • New Orleans **N. CAROLINA:** Charlotte • Greensboro • **S. CAROLINA:** Greenville • **TENNESSEE:** Chattanooga • Kingsport • Knoxville • Nashville **VIRGINIA:** Norfolk • Richmond

Thermal cycling ruined it...



Rewound rotor is balanced at National's plant to less than .0005" motion in free floating bearings. After complete testing, rotor was returned to service.

National rebuilds 63,333-hp rotor to last

This rotor for a wind tunnel motor took unusual punishment. Since loading of the motor continually changed, the rotor was subjected to severe thermal cycling. Expansion and contraction of coils in the slots broke down the mica ground insulation.

National rewound the rotor with new coils insulated with glass-fiber and resin. New design slot troughs of high mechanical strength were used. Now the insulation wall is extremely tough, solid and durable.

Whether your electric coil and rebuilding needs are standard or special, you'll be sure of performance when you call in National Electric Coil. We tailor-make the coils to fit your needs; offer all types of insulation. For information call National's Columbus plant... HUdson 8-1151 ... or call the nearest National field engineer.

NATIONAL COILS

National Electric Coil

COLUMBUS 16, OHIO • IN CANADA: ST. JOHNS, QUEBEC

DIVISION OF McGRAW EDISON

Browning Bucket Crane Servicing Steel Mill Scale Pit

Other cranes in steel plant service include: skull-cracker, ladle reconditioning, soaking pit, open hearth charging, ladle-handling, motor room, gantry and others of special design. Lifting capacity range exceeds 200-ton rating.

"Simple Design is Sound Design"

SIMPLICITY . . . Minimum maintenance, easy accessibility.

RUGGEDNESS . . . Trouble-free service under severe condititons.

DURABILITY . . . Many years of reliable performance.

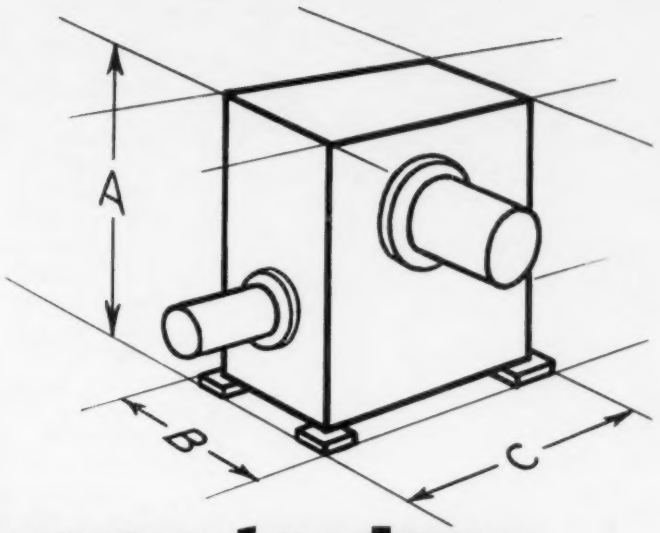
Your copy of the Browning catalog describing bridge cranes, trolleys and electric brakes will be sent upon request.

VICTOR R. BROWNING & COMPANY, Inc.

BOX 309, WILLOUGHBY (CLEVELAND), OHIO

Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes

Do-It-Yourself...



Let's design a speed reducer today

So you can't find a speed reducer to fit your latest brainchild without ruining the design? Doggone manufacturers all build reducers too big to fit into those few cubic feet you've got left for the reduction unit back behind the double-ended dingbat?

Revolt! Design your own! Show 'em!

By George, design it yourself and it'll fit. How? Well, you know your size limits. Draw the biggest box that'll fit the space and you've got your reducer housing specifications.

Now you need gears that will (1) transmit the needed horsepower under all operating conditions, (2) provide the ratio your machine requires and (3) fit the space that's available. You'll soon discover that there are limits to what gears can do in transmitting horsepower. The cheapest answer is parallel shaft helical gears. If they'll fit you're in clover. But they take the most room, especially when you're out of the fractional hp range. The right angle worm and gear combination is the most compact drive arrangement.

Here again you have a choice. Cylindrical worm gearing is often used, and if it'll do the job, is worth consideration. But it's not the most compact possibility. The best way to shrink gears and still carry the load is the double-enveloping worm gear design. Both worm and gear are throated and the two literally wrap around each other. This brings center distance of the two shafts closer together and you can put them inside smaller housings.

Does this reduce load capacity? No sir! You can carry the same load with center distances up to 33% smaller than those of cylindrical worm gears. Or use the same center distance and carry a greater load. Will these gears hold up in operation? Sure, if you beef up the teeth, the bearings and the housing. Use straight-sided worm and gear teeth and you'll get all the strength there you'll ever need. Use large taper roller bearings with real B-10 life. Use a reinforced, heavy wall housing that won't distort under load. Put fins on it for added cooling and increased thermal horsepower capacity to meet your needs. Now, put the whole thing together and you've got a speed reducer that's a dilly.

Designing your own speed reducer give you a headache? Looking for an easier way? There is one. Someone's already done exactly what you're talking about. You can order that compact speed reducer right off the shelf. Where?

Cone-Drive Gears, that's where!

Yes sir. They stock double-enveloping worm gear speed reducers from fractional to 665 hp. Standard ratios from 5:1 to 70:1 in about 15 increments, all interchangeable in any type housing of a given center distance. Worms over and worms under. Gear shafts vertical, too. Single- or double-extended output shafts, or shaft mounted. Over 200,000 combinations possible. Wow! Just about anything you want.

Better get Cone-Drive's new speed reducer catalog that details everything. Ask for Bulletin CD-218. Cone-Drive Gears, Div. Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

At Burnside Terminal . . .

Fast, efficient ship-to-barge bulk cargo transfer effects big savings for plants on inland waterways

A deep-water port facility, Burnside Terminal, Burnside, La., is a two-way transportation center for ocean-going vessels and river barges. Heavy bulk materials such as iron ore, manganese, bauxite, phosphate rock, coal, raw sugar, etc. can be transferred from ship to barge, barge to ship, ship or barge to storage, or from storage to ship or barge. As a result, plants located on the Mississippi River System can benefit from lower material costs and inexpensive barge transportation.

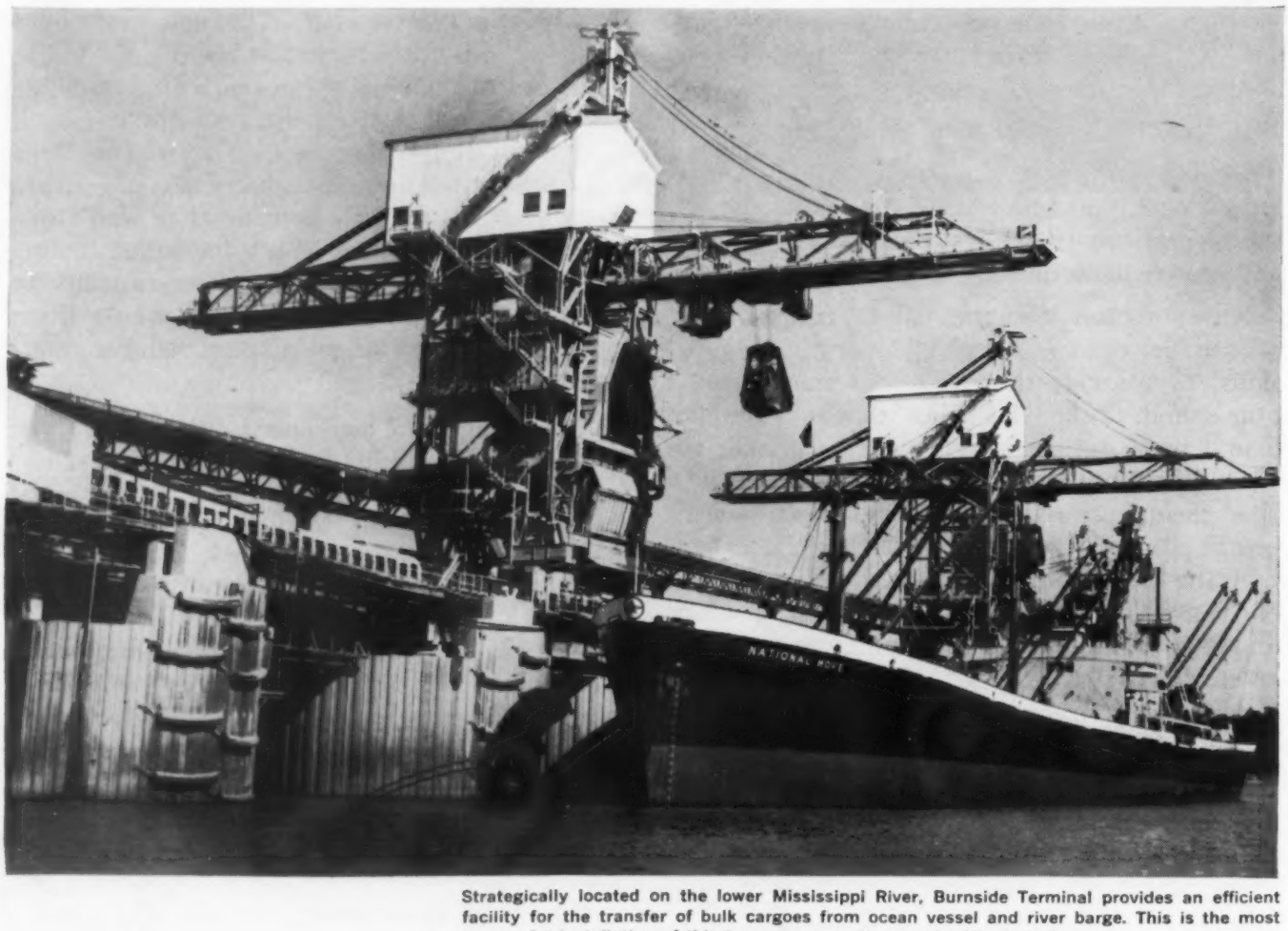
According to Captain H. O. Hall, assistant vice president of Ramsay, Scarlett & Co., Inc., operators of the terminal, the satisfactory performance of Dravo unloaders has been a major factor in providing this efficient, low-cost bulk cargo handling. Captain Hall puts it this way:

"Our Dravo unloaders help us substantially in assuring fast ship turn-around time.

"These cranes have lived up to the representations of the manufacturer. In fact, at times the free-digging performance in connection with bulk carriers has exceeded rated capacity.

"Because of the variety of bulk commodities handled here, speed in changing from one size of bucket to another is extremely important. With the new design of the Dravo unloader, the time required to change buckets generally is a matter of minutes."

This is typical of the benefits so many companies are getting with Dravo materials handling equipment. May we discuss your requirements with you? Write Dravo Corporation, Pittsburgh 25, Pennsylvania; or phone SPalding 1-1200.



Strategically located on the lower Mississippi River, Burnside Terminal provides an efficient facility for the transfer of bulk cargoes from ocean vessel and river barge. This is the most successful installation of this type now operating on the Mississippi.

DRAVO
CORPORATION

No. 3 Coil Preparation Line At Wheeling Steel Corporation's Yorkville Plant

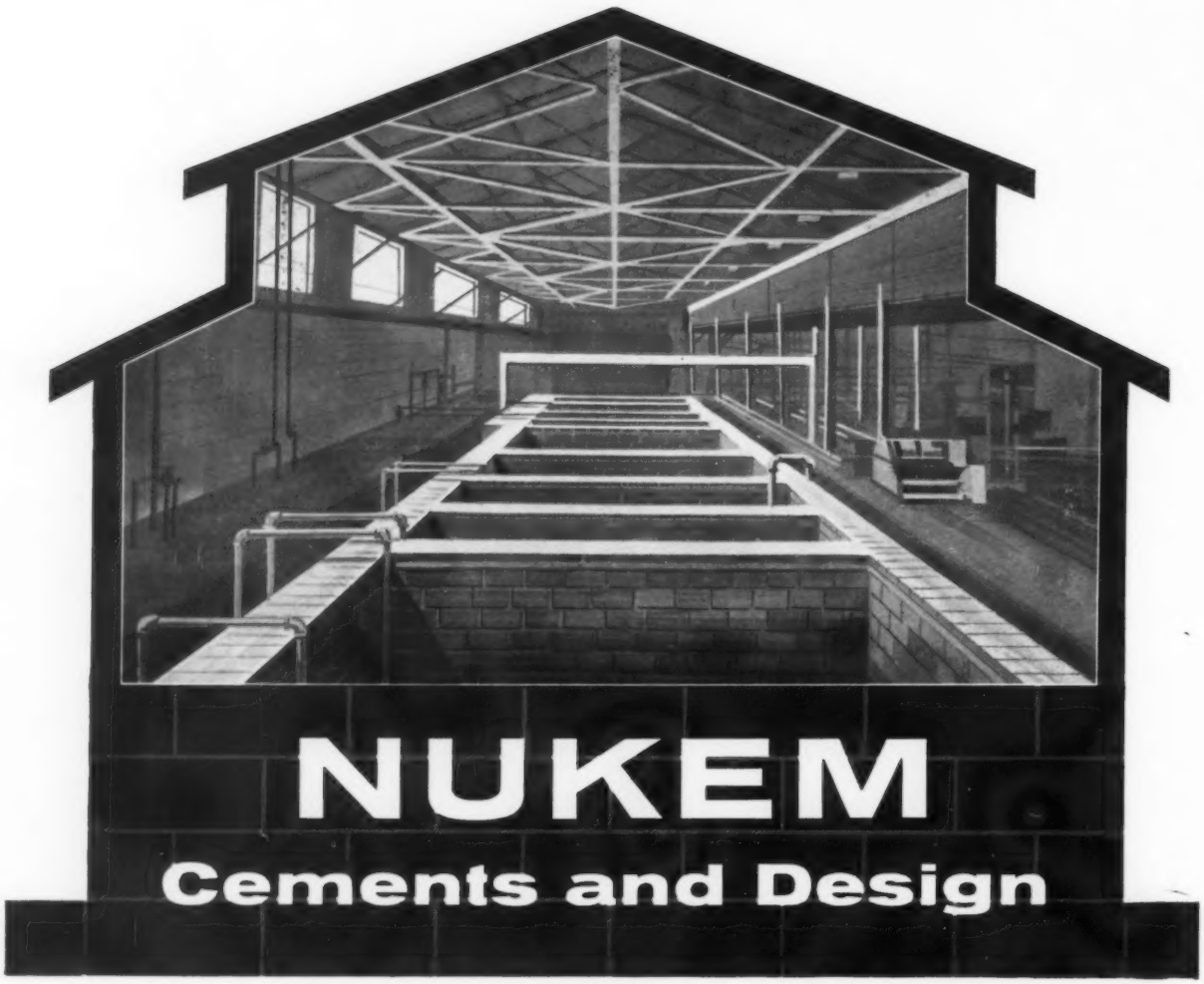
Wean, Wheeling and Coil Preparation . . .

Inspecting and side trimming coils at high speeds, this Wean coil preparation line at Wheeling Steel Corporation represents another advance in the development of high speed processing lines. This new Wean line is designed to produce oiled black plate, or to prepare coils of various gauges for tinning and galvanizing. Capable of handling coil weights up to 42,000 pounds, the No. 3 Yorkville line can side-trim strip up to 45 inches in width and from .006 to .0359 in thickness.

Other new features of the Yorkville line are a butt-type shear-welder that produces a very smooth joint, minimizing distortion in the wraps of built-up coils; and a non-contact thickness gauge with indicating and recording instruments.

Wean's "creative engineering" has developed modern coil preparation lines that offer speeds of over 4,000 fpm, increased efficiency and higher prime product yield in subsequent coating operations. Wean experience in this field can be a valuable asset if coil preparation lines are part of your production planning.

THE WEAN ENGINEERING COMPANY • WARREN • OHIO



...add years of service to your tanks and foundations

Sulphuric, hydrochloric, nitric or hydrofluoric acids... nickel salts or caustics... no matter what corrosive solutions your processes require, there is a Nukem cement designed for your service.

For over 35 years, Nukem has specialized in the manufacture of a complete line of acid and/or alkali proof cements and linings—each bearing the hallmark of "top quality." Over this same period—employing these products—the name NUKEM has been associated with successful, reliable, corrosion proof construction of Pickling Tanks, Neutralizing Systems, Foundations, Manholes, Trenches and Sewers.

Permanent, satisfactory results depend upon accurate analysis of the problem and selection of the exact material to meet every requirement. Proper design is essential and Nukem engineering "know-how" is at your service. For lasting and economical corrosion resistance, be sure you specify NUKEM.

NUKEM CEMENTS

- NUKEM BASOLIT
- NUKEM SILICATE CEMENT
- NUKEM SUPERTITE
- NUKEM ALL PURPOSE RESINOUS CEMENT
- NUKEM MULTIBOND CEMENT
- NU-KLAD

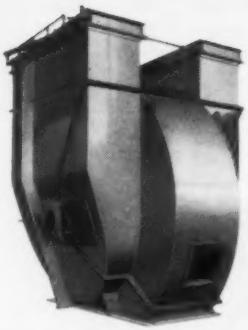
For information and illustrated technical data write:

NUKEM PRODUCTS CORP.

Dept. 5F • 111 Colgate • Buffalo, N.Y.

A Subsidiary of Amercoat Corp.

N 102

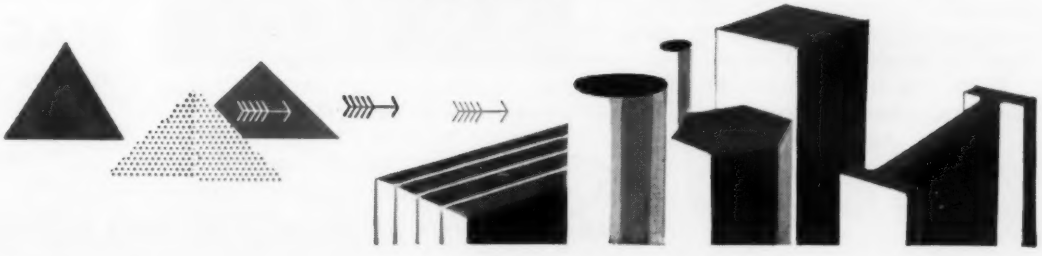


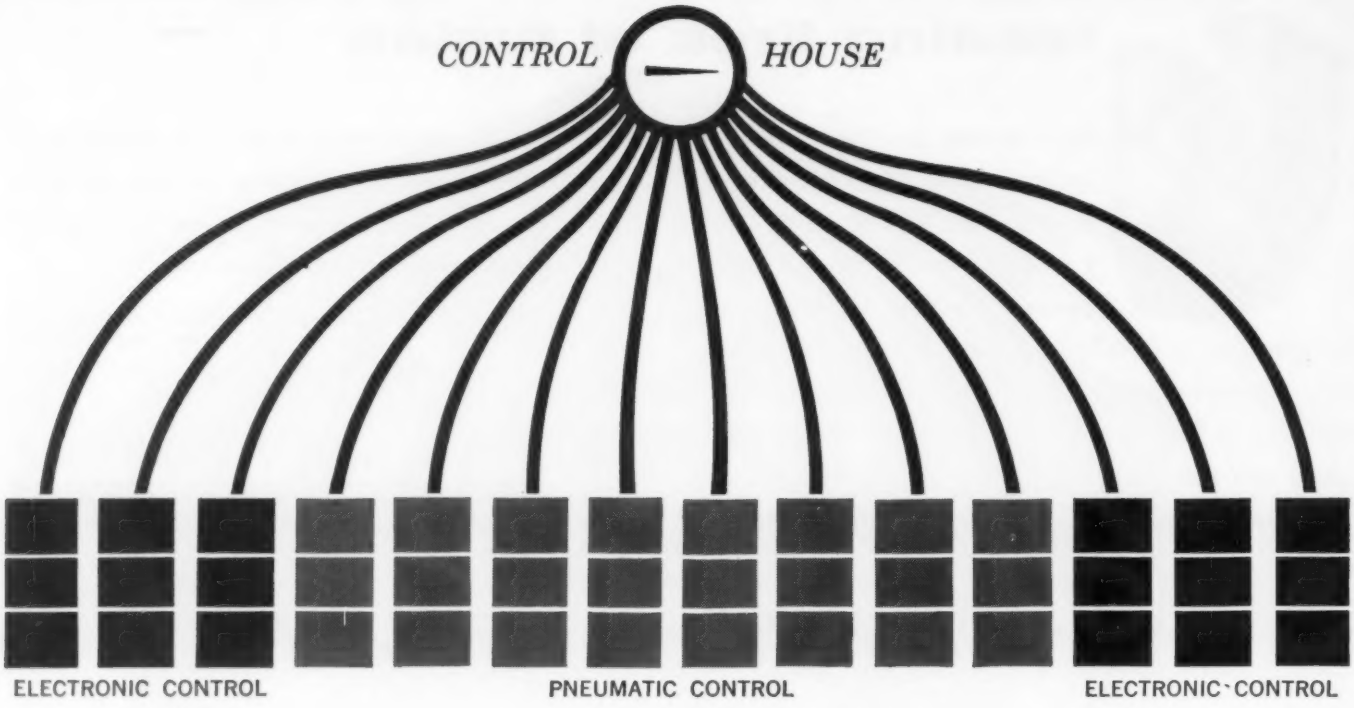
feeding fires of fusion

Huge sintering fans from American-Standard Industrial Division help form the blast furnace charge with enormous amounts of air for combustion and exhaust. Constructed to individual order, these fans are made with single or double inlet, in pressures up to 45" wg., for volumes up to 500,000 cfm. They're rugged, and easily accessible. Sintering fans, along with American-Standard* Industrial Division centrifugal compressors, special-purpose and standard-duty fans, handle air and gases throughout the entire steel-making process. May we serve you? American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario.

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

American-Standard
INDUSTRIAL DIVISION
AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS



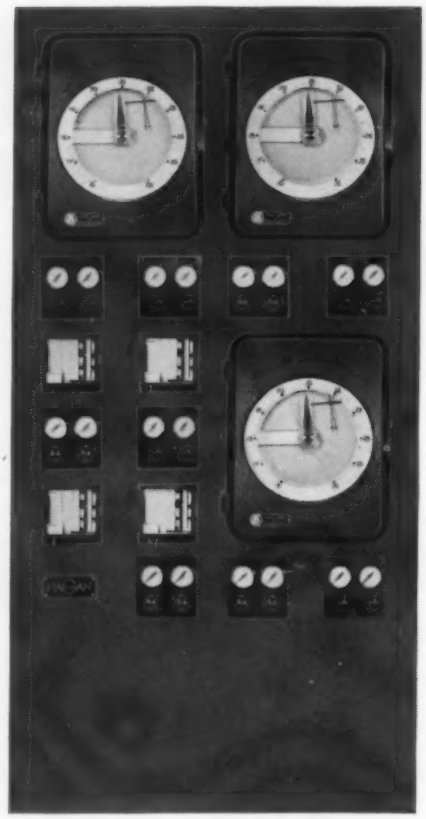


Centralized control puts panels for 42 SOAKING PITS in a single 50-FOOT CONTROL HOUSE

A major steel producer engaged in an expansion program projected the building of 42 new soaking pits, arranged in 14 rows of 3 pits each, *but the space available for a centralized control house was only 50 feet long.* In addition, each panel must provide high visibility of pit temperatures, heaters wanted to be able to see the entire trend of the heat on recorder charts, metallurgists wanted daily access to individual pit temperature and fuel flow records, the instrument department wanted chart changing held to a minimum.

Two recent Hagan developments provided the solution to this problem—one was a new instrument which records both pit temperature and fuel input on a single 24-hour chart, and has a highly readable pit temperature indicator. The other was the use of Hagan PowrMag electronic (magnetic amplifier) control for the 6 rows of pits furthest from the central control house. Row variables—flue pressure, air pressure, combustion air pressure and recuperator temperature—are recorded on standard 30-day miniature strip chart instruments.

With this arrangement, all of the user's requirements were met. Here are the details on how it works out:



Complete control for one 3-hole row of soaking pits is housed in this 3½-foot panel.

1. Panel width is exactly 3½ feet per 3-hole row, so the panels for all 42 pits total 49 feet. This permits the use of the desired centralized control house, attended by one heater.
2. Only one chart per pit will be changed daily. This can be done when the instrument man date stamps the 30-day charts.
3. The entire record of a heat is visible on the 24-hour chart without need for withdrawing the instrument from its case.
4. The indicating scale showing pit temperature has high visibility—the heater will have no difficulty keeping track of each row.

Hagan electronic and pneumatic controls are designed with the need for centralized control in mind. For assistance with your particular problem, write or phone for a Hagan engineer. For specific information on soaking pit controls, **ask for Bulletin MSA-177.**

HAGAN

CHEMICALS & CONTROLS, INC.

HAGAN CENTER, PITTSBURGH 30, PA.

HAGAN DIVISIONS: CALGON CO.—HALL LABORATORIES—BRUNER CORP.

FIVE-DEEP

Millions have been made and saved

with UCM's "FIVE-DEEP" Ferroalloys

Metal producers in their ceaseless drive to improve products and profits are learning the value of Union Carbide Metals' FIVE-DEEP ferroalloys. Here are some of the advantages these alloys provide.

Five Extra Values in Depth

1 **Technology**—many million dollars a year, invested in UCM's 600-man research and development center—helps you produce more profitable metals. The payoff has been progress—over 100 new alloys and metals—providing countless ways to improve your products.

2 **Customer Service** brings you our integrated experience in the application of ferroalloys to various melting practices. Engineers from 9 UCM field offices travel a million miles a year to provide on-the-scene technical assistance.

3 **Global Ore Sources** assure you uninterrupted supplies of ferroalloys. UCM's close association with many mines throughout the world provides dependable raw material sources.

4 **Unmatched Facilities** free you from delivery worries. Only UCM gives you 6 plants—3 with their own power facilities—and 17 warehouses, all located for fast shipments by rail, truck, or water.

5 **Strictest Quality Control**—with over 100,000 tests per month from mines to shipment—makes sure you always get alloys of uniform size and analysis, with minimum fines, lot after lot.

For better metals, production economies, bigger profits, insist on UCM's FIVE-DEEP alloys. Union Carbide Metals Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y., producer of "Electromet" brand metallurgical products.

"Union Carbide" and "Electromet" are registered trade marks of Union Carbide Corporation.

UNION CARBIDE METALS

Only **ELECTROMET** ferroalloys from **UCM** are so deep in extra values to help you.

Operation: Descaling

(One of a series)

Pangborn Rotoblast proves itself again...and again...and again...and again!

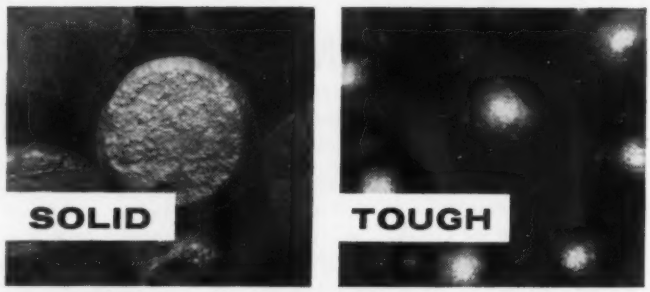
Bustin Steel Products, Dover, N. J.—In descaling steel bars, Pangborn Rotoblast saves $75 a day over pickling *plus* the cost of degreasing.

Kelsey-Hayes Co., McKeesport, Pa.—Pangborn Rotoblast descales steel sheets at 30% to 40% below cost of previous pickling method.

Southwestern Pipe Inc., Houston—Pangborn Rotoblast enables this company to save by buying hot rolled stock instead of cold rolled or pickled and oiled stock.

Midwest Auto Parts Manufacturer—Pangborn Rotoblast saves this firm $1 a ton, or $10,000 per month in descaling costs.

Above are just some of the successful Pangborn Rotoblast installations. If *your* problem has to do with descaling, talk to your Pangborn man or write PANGBORN CORPORATION, 4400 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Blast Cleaning, Vibratory, Dust Control Equipment—Rotoblast® Steel Shot and Grit.*



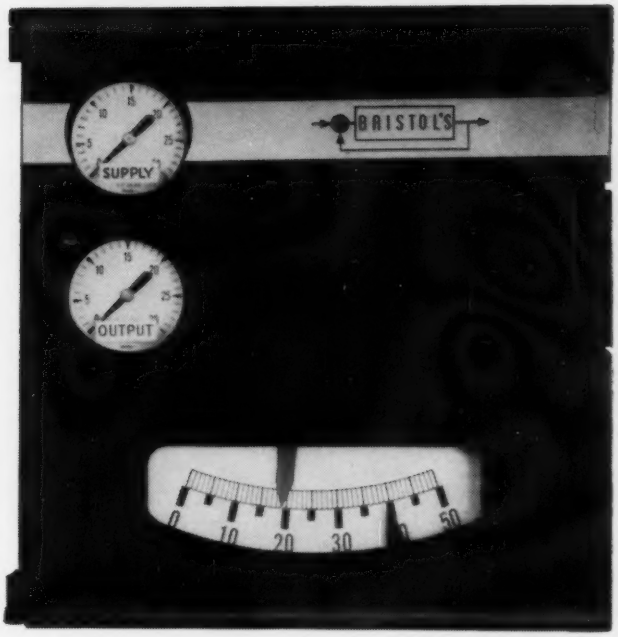
Rotoblast Steel Shot and Grit prove their value, too . . .

. . . made by exclusive processes to produce a *solid*, *tough* abrasive. Used in today's blast cleaning equipment, Rotoblast Steel Shot and Grit hold up for many more passes than ordinary abrasive, reducing replacement and cleaning costs.

Pangborn

OF HAGERSTOWN

NEW BRISTOL'S



Series 624 A/D* pneumatic controller features simplicity and high control stability

- **Simple modular design for ease of servicing**
- **High control stability for closer process control**
- **Designed for batch-type and continuous processes**
- **Proportional and proportional-plus-reset control models available**

Top control performance with maximum simplicity plus standard Bristol precision measuring elements—those are the key features of the Bristol Series 624 Controller. The 624 uses the same renowned elements that have earned such a reputation for accuracy and dependability on other Bristol automatic controlling and recording instruments—perfected through wide experience and many years of development.

Self-contained modular design of the control unit speeds servicing. The whole modular unit, consisting of an aluminum casting with working parts made of stainless steel, Ni-Span C, and Neoprene diaphragms, can be removed by taking out only two screws and a link.

Outstandingly compact, the aluminum instrument case (only 8" x 8" x 5" overall) is completely weatherproof. It is designed for either flush, surface, panel, or valve mounting. Attachments for pipe mounting (2-inch pipe) are available. Write for complete data on the versatile and economical 624 A/D. The Bristol Company, 123 Bristol Road, Waterbury 20, Conn. 0.35

**Advanced Design*

CONTROLLERS OFFERED FOR:

PRESSURE AND VACUUM: Ranges from full vacuum to 10,000 psi.

TEMPERATURE: Ranges from —100°F to +1000°F.

FLOW AND DIFFERENTIAL PRESSURE: With mercury-type manometer and dry-type differential unit.

LIQUID LEVEL: With bulb unit and mercury manometer and dry-type differential unit.

HUMIDITY: Zero to 100% relative humidity.

CONTROL UNIT CHARACTERISTICS:

PROPORTIONAL BAND: 0-400% continuously adjustable, direct- or reverse-acting.

RESET: 0.1 to 50 repeats per minute.

AIR PILOT: Non-bleed type.

PILOT CAPACITY: 4.0 scfm.

FREQUENCY RESPONSE: Flat to 400 cycles per minute.

TEMPERATURE STABILITY: Less than 0.1% change in the output pressure for 90°F temperature change.

MATERIAL: Aluminum housing; 316 stainless steel internal parts; Ni-Span C feedback element.

BRISTOL... for Improved production through measurement and control

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Pre-Engineering by **KAISER ENGINEERS** answers basic plant expansion questions...

Timely? Many complex factors shape the final decision to proceed with your expansion plans...and timing is an important one. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. The studies and evaluations furnished by KE Pre-Engineering represent only one phase of total KE services. Kaiser Engineers designs and builds for the Steel industry...offers skilled experience in all types of facilities from raw material plants to finishing mills. From Pre-Engineering through design and construction, Kaiser Engineers provides complete, one-company service and ingenuity based on years of experience.

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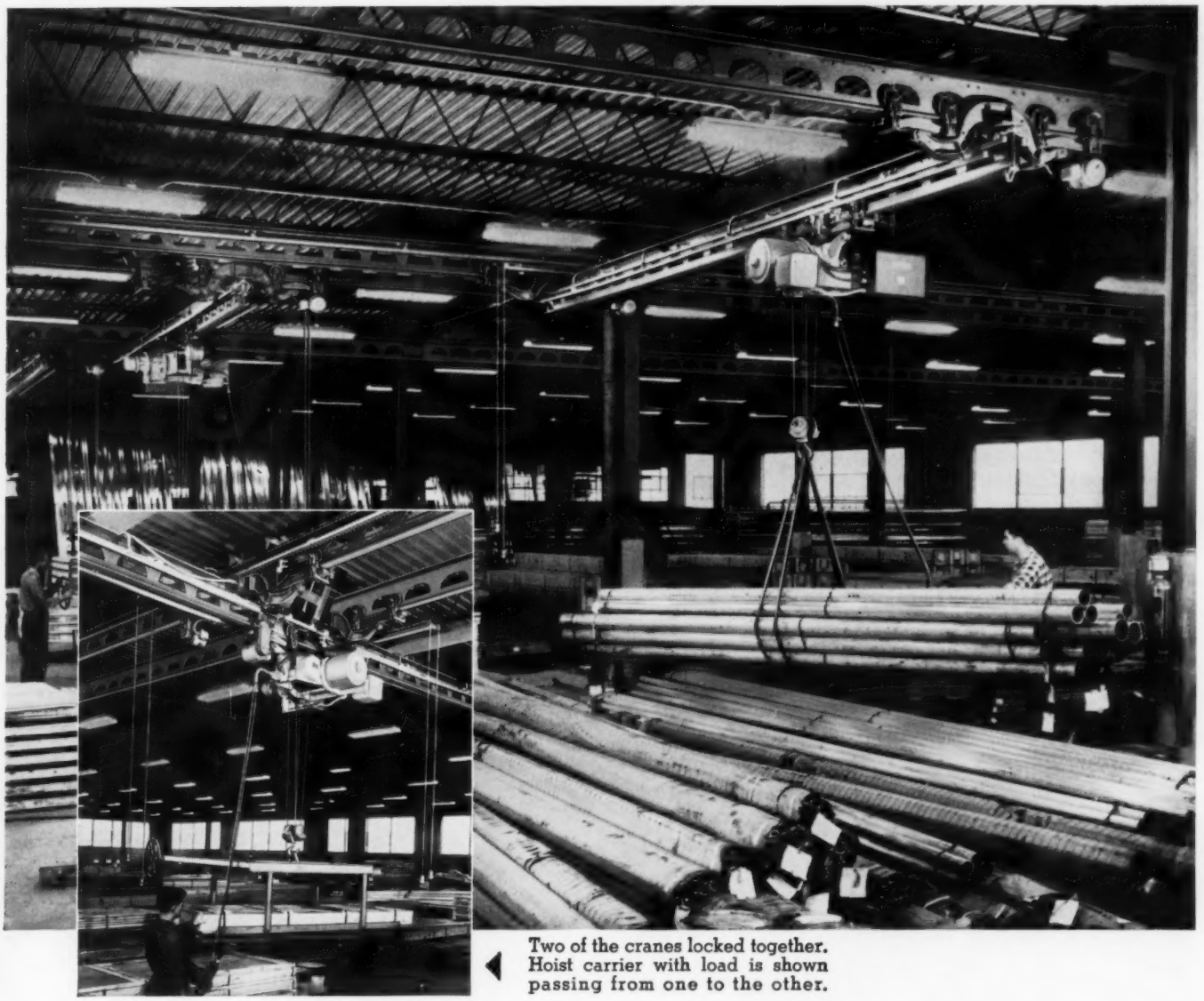
6228-S

Large bundles of pipe, sheets, etc., are quickly handled from receiving dock to any spot in the warehouse *without rehandling* by the overhead Cleveland Tramrail transfer cranes. Whitehead Metal Products Co., Inc. specialize in a wide variety of nonferrous metals.

TRAMRAIL CRANES
SAVE WAREHOUSE SPACE
Improve Materials Handling Efficiency



Two of the cranes locked together. Hoist carrier with load is shown passing from one to the other.

In the large modern warehouse of Whitehead Metal Products Co., Inc., Cambridge, Mass., the entire job of unloading incoming materials, placing in storage and handling for outgoing shipments is done with Cleveland Tramrail transfer cranes.

The cranes have proven most practical for this service. They can transport long, unwieldy bundles of pipe in much narrower aisleways and turn them ninety degrees for piling without need of wide turnaround areas. As a result, an important amount of floor space is saved, and this provides considerable additional storage capacity.

Three cranes on separate, adjacent runways are used at Whitehead. However, there are only two hoist carriers, one of two tons, and the other of three tons capacity. Either can be transferred to any crane. The equipment is completely motorized, push-button operated. Conductors are SAFPOWRBAR. (SAFPOWRBAR electrification has been approved by the Underwriters Laboratories, Inc. and the Canadian Standards Association.)

Hundreds of warehouses handling materials of nearly every kind are profiting by installations of safe, dependable, time-saving Cleveland Tramrail cranes and track systems.

Write for free Engineering and Application Booklet No. 2008. Packed with valuable information.

CLEVELAND TRAMRAIL

Overhead Materials Handling Equipment

CLEVELAND TRAMRAIL DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. • 5045 E. 290 ST. • WICKLIFFE, OHIO

TRABON®

CENTRALIZED LUBRICATING SYSTEMS

1/3 of a mile of brand-new, ultra modern steel mill at U. S. Steel's Duquesne Works is equipped with Trabon automatic centralized lubricating systems.

33 "original container" barrel pumps, each with its own automatic control and central warning system, serve the components of this tremendous new facility.

Included are the Mesta 45" slabbing mill and shear, Birdsboro 36" blooming mill and shear, United 21" billet mill and traveling hot saws, Morgan flying shear, Linde Descarfer, Morgan, Alliance and Cleveland cranes, ingot buggy, tables and accessory equipment. It is indeed significant that the designers of this fine new mill selected Trabon.

In buying new or rehabilitating old machinery don't overlook the importance of a good lubricating system. When you specify Trabon — you get the best!

4522 Bearings at U. S. Steel's Duquesne Works expansion protected by TRABON

The new 36" Birdsboro Blooming Mill is served by a Trabon heavy-duty Type MX System — *completely automatic — completely positive — and providing immediate central warning* at the control panel. Reset indicators in all valves quickly pinpoint trouble when central warning is given.

"Centralized" OIL AND GREASE SYSTEMS *"Meterflo"* CIRCULATING OIL SYSTEMS *"Meter-Mist"* OIL SYSTEMS

Trabon® **Trabon Engineering Corporation** 28785 Aurora Road • Solon 39, Ohio

Equipment News...

WEATHERPROOF MOTOR

△ A completely new line of open weatherproof a-c motors with an epoxy encapsulated insulation system has just been introduced by Reliance Electric and Engineering Co. The new Duty Master Weatherproof Motors are currently available in frames 180 through 445U (1 through 125 hp) in all standard speeds and voltages.

The stator windings are thoroughly encapsulated in a specially formulated epoxy resin for resistance to moisture, oils, dust, chemicals, acids and alkalies. The bearings, exposed internal metal surfaces, hardware and mechanical parts are also protected against damage from the elements and contaminating atmospheres in all types of indoor and outdoor applications.

The full Class "B" insulation system is built around the thixotropic (it won't change form with heat) epoxy resin which is applied by a unique vacuum impregnation process. The system employs polyester round copper magnetic coil wire, epoxy-insulated glass fibre sleeving, epoxy-treated glass fibre cloth slot liners and phase insulation. Separators and top sticks are glass mat base epoxy resin laminate, and lead cable is protected by moisture-proof silicone rubber.

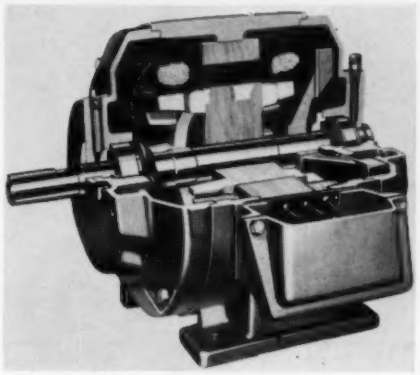
In the exclusive vacuum impregnation and pressure process, the wound stator core is preheated to drive out gases and moisture, and placed in a pressure vessel and vacuum-drawn. Epoxy resin is then introduced into the vessel to submerge the winding. The vacuum is maintained to allow the resin to penetrate the coil slots and heads. Next, pressure is applied to the submerged core. The stator, now encapsulated in a solid, void-free protective insulation, is removed from the pressure vessel, drained and baked in large curing ovens.

The unique insulation system uniformly coats the motor windings to permit excellent heat dissipation, while producing exceptionally high resistive properties, flexibility and bond strength.

An open motor that exceeds splash-proof motor specifications, the new unit is protected in a solid cast-iron frame. The cast-iron conduit box is diagonally split with a gasketed cover for easy access to leads. A neoprene gasket between the motor housing and conduit box holds the numbered leads by means of pressure knobs. Hex-head, zinc-plated bolts are used throughout.

Reliance "metermatic" lubrication system is employed with the deep-groove, double-shielded ball bearings. A metering plate helps keep out contaminants while regulating the precise flow of fresh grease to the bearing as needed. Automatic grease relief is provided. A neoprene slinger on the pulley end of the motor and a shaft cap on the opposite end prevent the entry of moisture and foreign matter along the shaft.

A special rust-preventing coating is applied to all internal metal surfaces such as the rotor, stator and air deflectors. All metal-to-metal fits are greased to keep out contaminants. The stainless steel nameplate withstands corrosive atmospheres and keeps motor information permanently available.

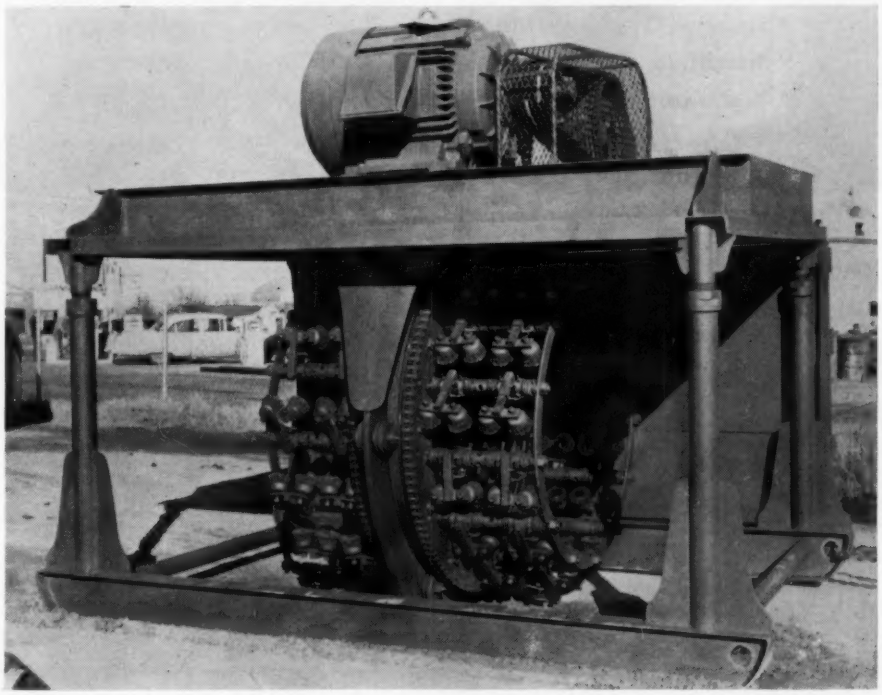


ANNEALING FURNACE

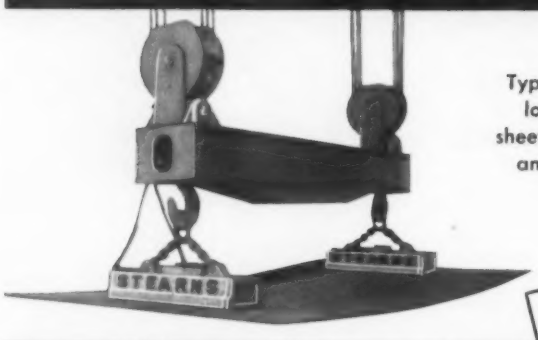
△ A new high-production furnace for continuous bright annealing of stainless steel strip has been an-

GIANT PIPE CLEANING UNIT REMOVES MILL SCALE

Remco Manufacturing Co. recently completed this mechanical cleaning machine for use in an eastern steel plant to remove mill scale from newly manufactured pipe. Capable of cleaning 24 in. through 42 in. pipe, the complete machine weighs 20,000 lb. The actual cleaning is performed by rotary cup cleaning brushes. While rotating around the pipe each set of two brushes operate in a counter rotating manner. The brushes are held at an angle to the pipe to actually dig into the surface and remove all scale, dirt, lacquer and other foreign matter.

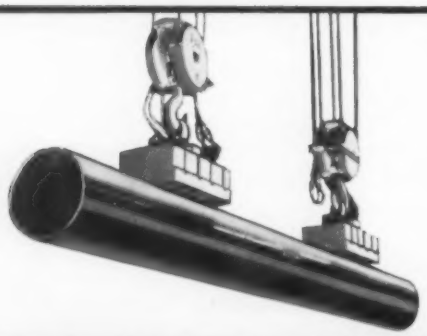


STEARNS lifting magnets make the tough jobs easy



Typical lifting arrangement for long, flexible, hard-to-handle sheet stock, using spreader bar and two rectangular magnets.

STEEL-MILL APPROVED



Two Stearns rectangular magnets work together providing fast, damage-free handling.

Dividends paid by magnetic handling go up when you specify STEARNS...the lifting magnets with real value built in.

Stearns' value means the highest performance and durability at the lowest cost. You can't buy better magnets at any price.

Check these advantage-features:

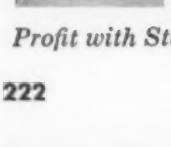
- **Cool Operating** — advanced coil design.
- **Superior Over-all Lifting Power** — extra-deep magnetic field.
- **Simplified Maintenance** — renewable bolted pole shoes.
- **Waterproof Construction** — all-welded magnet case.
- **Coil Life Safeguard** — automatically controlled oven-curing.
- **Protection Against Shorts, Leakage, Burnouts** — special class "H" insulation.

Standard circular or rectangular magnets are available in either bolted or all-welded styles, in a wide range of capacities and sizes:

Circular — 20" to 77" dia.

Rectangular — 9" x 24" to 26" x 80"

Whatever your steel-handling problem, Stearns engineers have the answer with built-in value.



Call in your local Stearns representative for a job-studied recommendation and price quotation, or write for Bulletin No. 35-C-J.

STEARNS MAGNETIC PRODUCTS

DIVISION OF INDIANA GENERAL CORPORATION • VALPARAISO, INDIANA

635 South 28th Street • Milwaukee 46, Wisconsin

Profit with Stearns — First with Ceramic Magnet Separators for Industry

nounced by the General Electric Co.

This electric furnace, designed and to be manufactured by the company's Industrial Heating Department, Shelbyville, Ind., allows bright annealing at production rates as high or higher than existing anneal and pickle lines at approximately 50 per cent lower cost per ton. Extensive tests on various types of stainless strip processed in the department's laboratory prototype furnace have shown improved corrosion resistance, appearance and physical properties over strip annealed by conventional methods. Department engineers state that the furnace is fully tested and ready for production.

The furnace prevents the formation of scale on the strip through the utilization of very pure and dry (−60 F dewpoint) hydrogen or dissociated ammonia atmosphere. At this dewpoint, the atmosphere is 99.995 per cent dry. Thus, the strip does not require passes through pickle baths to remove scale formed in conventional stainless steel annealing furnaces.

Vertical construction of the furnace makes possible a reduction in the amount of floor space necessary and assures that minimum tension is placed on the strip during annealing. The strip is heated and cooled during the single downward pass through the furnace, where it touches nothing but pure and dry atmosphere while at elevated temperatures. High tensions associated with horizontal catenary furnaces, which can reduce gage and width and distort the strip, are not required.

Stainless steel strip is fed into the furnace in an inverted "U" pattern after it has been cold rolled. The strip moves up the back side of the furnace until turning over the top roll and then downward for the heating and cooling pass.

On the downward pass, the strip first enters the muffleless heating chamber where it is rapidly heated to annealing temperature by direct radiation from molybdenum heating units. A high-purity insulation system permits operation of the furnace at high temperature and with high-purity atmosphere without muffles. This muffleless construction allows a faster heating rate for the strip and eliminates costly muffle main-

Weigh Molten Steel In Transit With ASEA's Pressductor

Save one big step with this new application of Asea's Pressductor. The Pressductor measures the accurate weight of molten steel or other crane suspended loads in transit. Gone is the non-productive, tedious–and frequently inaccurate—weighing stage. Here is how it works: mounted on the crane (and it can be easily installed), the Pressductor **A** senses the load, gives rise to a changing magnetic flux. This induces a voltage which is then read on a pointer–indicating instrument **C** a digital voltmeter **D** paper tape or a punched card recording unit **E**. The Pressductor can be connected to a device giving a signal when crane is overloaded **B**. The indicator can be placed in the operator's cabin or mounted on the crane, so that it can be seen from the ground. This is the very same compact Pressductor which is used in most rolling and strip mills to measure and register heavy roll pressures. It allows uninterrupted production, gives you accurate weighing, can supply a permanent record of every stage of your operation with a minimum of attention and maintenance. It does not involve any major change in your crane—and Asea will supervise the installation. For further information, full details, specifications, write to: ASEA ELECTRIC, INC., 500 Fifth Avenue, New York 36, N. Y., 55 New Montgomery Street, San Francisco, Calif.

ASEA

tenance and replacement.

After reaching annealing temperature, the strip moves down into the adjacent cooling chamber where it is rapidly cooled by high-velocity hydrogen or dissociated ammonia.

When the stainless steel strip reaches the delivery end of the furnace, it has been cooled to a temperature of 200 F, and is ready for coiling. The exit seals are the first surface the strip touches after leaving the top roll on the downward pass.

The furnace can be supplied in two heights, approximately 54 and 75 ft. In a typical application—annealing Type 430 stainless strip, 0.020-in. thick, at 2000 F—the furnace can handle 60 ft of material per minute. For strip 24 in. wide, the furnace would have a capacity of 6000 lb per hour.

Furnaces are also available to process strip widths of 12, 36 and 48 in. In addition, General Electric furnishes the atmosphere producers and conventional strip handling equipment to complete the furnace system.

LUBE SPRAY SYSTEM

△ An innovation in spray lubricating industrial gearing has been announced by Farval Division, Eaton Manufacturing Co. Where frequency of lubricating single, heavy-duty gears is no problem but inaccessibility presents a danger to maintenance personnel, this new, versatile spray system offers an inexpensive, efficient method of lubrication.

With a hand grease gun attached to a conveniently located fitting, lubricant will be sprayed as long as pumping is continued. Lubricant pressure forces down a spring-loaded piston, opening porting to the spray control valve. This allows air and lubricant, each under its separate pressure, to be forced through the spray nozzle. When lubricant flow ceases, the piston returns to its original position, closing the ports. The air supply is then shut off, limiting compressed air consumption to the amount needed for each delivery of oil or grease.

SELF-DUMPING HOPPERS

△ The Mason Department at U. S. Steel Corp.'s South Works, Chicago, Ill., has reduced waste handling time and costs by replacing motorized waste carts and wheelbarrows with a system of self-dumping hoppers and fork trucks.

Hoppers of one yard capacity

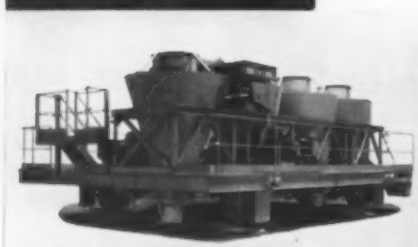
Fork trucks carry full hoppers to dumping site where operator releases lever on rear of hopper to permit automatic dumping. After dumping, hopper rights itself and locks, ready to be returned to furnace. Checkers are loaded into gondola car by front end loaders.

QUENCHER LOCOMOTIVE

DOOR MACHINE

COKE ON THE MOVE

Operating economy and long life, again, are major advantages of Atlas equipment for highly specialized coke-producing service. Specially designed and ruggedly built to your exacting requirements.



COAL LARRY

COKE QUENCHING CAR

ATLAS CAR & MFG. COMPANY

Since 1896, Engineers-Builders of Ore Transfers...Scale Cars...Coke Quenchers...Coal Larries...Door Machines...Safety-Type Transfers ...Storage Battery Locomotives.

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From 150 years' experience in the manufacture of special steels for special uses come parts for extrusion presses by Marathon. Developed to assure excellent service life at reasonable cost, Marathon parts are precision made for each application. Our Technical Bulletin EP11 will be sent on request. Immediate attention given to your inquiries.

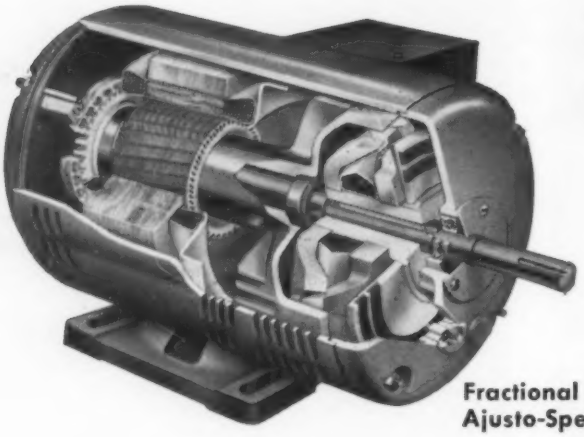
MARATHON

SPECIALTY STEELS, INCORPORATED

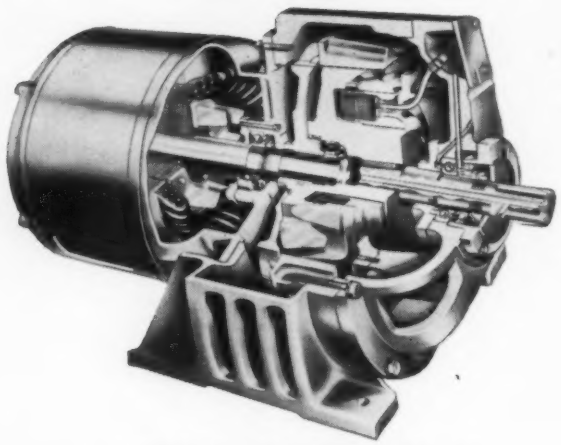
A Division of Deutsche Edelstahlwerke A. G., Krefeld, West Germany DEW 375 Park Avenue, New York 22, N. Y.

Bring Your Speed Control Problems to

EDDY-CURRENT HEADQUARTERS



Fractional HP
Ajusto-Spede Drive



Air-Cooled Ajusto-Spede Drive

EATON
DYNAMATIC
®

Let Our Years of Speed Control Experience Go to Work for You!

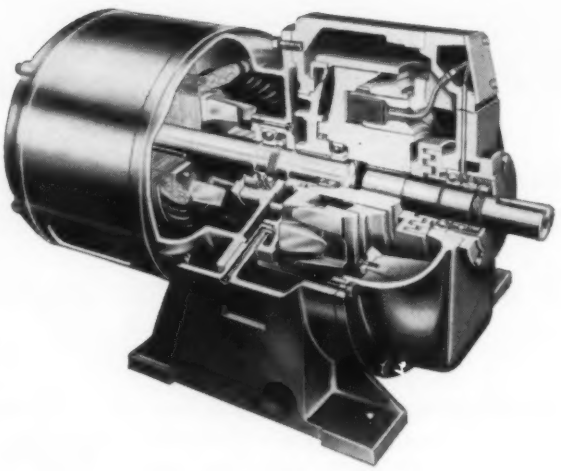
30 years ago Dynamatic pioneered the utilization of eddy-currents in industrial rotating equipment. Today, the Dynamatic Division of Eaton Manufacturing Company is the recognized leader in the development and production of eddy-current drives, couplings, brakes, and dynamometers—equipment which is solving production problems in every major industry.

In speed control applications, Eaton-Dynamatic Eddy-Current Equipment offers many exclusive advantages—stepless adjustable speeds from AC power, rapid response, wide speed range, quiet operation, low power loss, low maintenance cost, remote control, simple electronic or transistorized control.

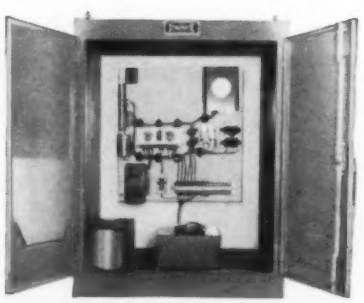
Dynamatic Eddy-Current Equipment is available in sizes from 1/4 hp Ajusto-Spede Drives to heavy-duty couplings rated up to 20,000 hp—and larger.

When you have a speed control or drive problem, bring it to "Eddy-Current Headquarters"—we can provide a simple, economical solution.

Write for Illustrated Descriptive Literature



Liquid-Cooled Heavy-Duty Drive



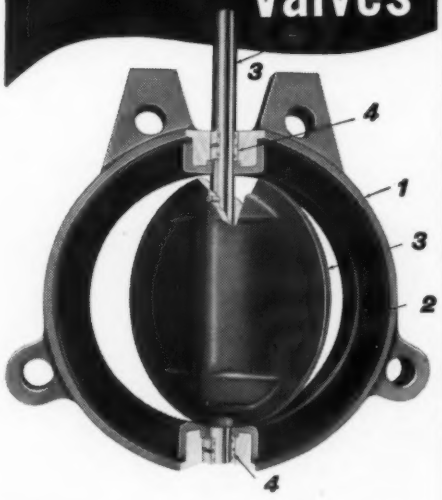
Magnetic Amplifier (Transistorized) Control

EATON

EATON
DYNAMATIC DIVISION
MANUFACTURING COMPANY
3122 FOURTEENTH AVENUE • KENOSHA, WISCONSIN

PACKED with COMPETITIVE ADVANTAGES

ROCKWELL Resilient-Seated Butterfly Valves



1 Less weight, space and cost: Valve face-to-face, overall height and weight are one-fourth to one-eighth those of gate valves. Cost less initially and are easier to install.

2 Drop-tight, leakproof closure. Resilient elastomer liner forms positive seal with disc. Liner removable on the job.

3 Disc and shaft assembly designed for highest rated pressure under most severe operating conditions; always operable manually or automatically.

4 True close bearing fit for shaft; non-leaking, non-galling, corrosion-resistant.

5 And what is quite obvious: the streamlined, self-cleaning design that eliminates cavities and voids in body; low pressure drop; no fouling. Valve can be installed in any position.

Bulletin 590X gives all the powerful facts. Write for a copy.

W. S. ROCKWELL COMPANY
2360 Eliot St. • Fairfield, Conn.

Made and sold in Europe by
COCKBURNS, Ltd., Glasgow S.W.2, Scotland

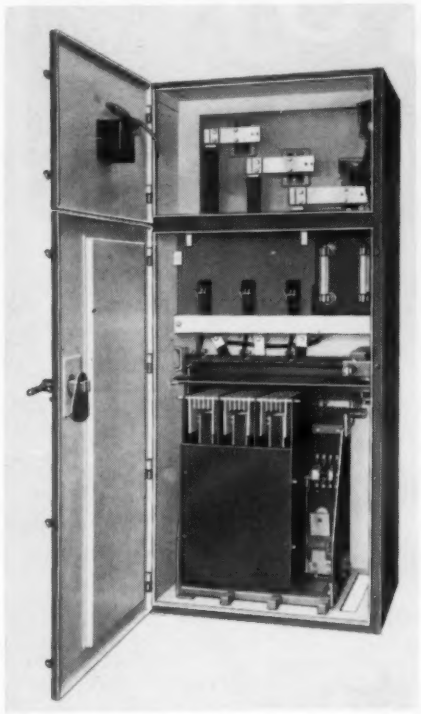
made by Roura Iron Works, Inc., are handled by the existing fork truck fleet.

Previously, when blast furnaces were relined, checkers were handled by wheelbarrows because space limitations prohibited the use of carts. With the fork truck-hopper system, hoppers are spotted at the furnace. Work is done faster because men do not need to leave the furnace to haul waste.

Hoppers are also used to collect flue dust, move silicon sand from storage to work sites and to carry lights and tools between job sites.

STARTER

△ A high-voltage air-break starter which combines fuseless fault protection with simplified servicing is available from EC&M Division of

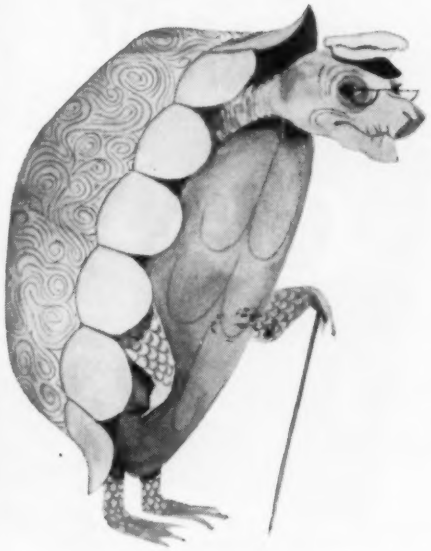


Square D Co. Certified interrupting capacity of the Type ZHA starter is 100,000 kva at 2400 volts and 150,000 kva at 4800 volts.

The phase barrier and arc-chutes slide out horizontally, eliminating roll-out and providing easy inspection and maintenance. Both front and rear contact tips are readily accessible. Since all maintenance can be done from the front, the starters can be mounted against walls or back-to-back.

A three-way door-interlock gives positive personnel safety. With the door open, blades are visible in the open and grounded position. Bus bars are used throughout.

TOPS in LONG LIFE



TM Alloy Chain winks at work—outlasts all other grades of chain by a wide margin. "Brute strength"—tensile of 125,000 lbs. psi . . . tough, stress-free links . . . uniform heat-treating make the big difference. Custom made to your specifications . . . tested to double their working load limit and backed by Taylor's Test Certificate. See your distributor or write for Bulletin 14.
S. G. Taylor Chain Co., Inc.
Hammond, Indiana

Everything Swings on TM Slings

Taylor Made CHAIN SINCE 1873

TRIP DEVICE

△ A static overcurrent trip device with no moving parts has been announced for Allis-Chalmers Manufacturing Co.'s Type LA low-voltage circuit breakers to provide greater accuracy, reliability and more desirable tripping characteristics than existing oil or air time delay devices.

Self-contained, the new device requires no external source for tripping. Timing and tripping are performed by the static trip units energized from tripping transformers mounted on the circuit breaker.

The device has an 80 to 200 per cent variable pickup and an instantaneous pickup which is adjustable from four to 30 times the minimum pickup setting of the breaker, as compared with 500 to 1500 per cent now available, to provide instantaneous response at lower or higher values of short circuit current.

Adjusting pickup current over a considerable range is easily accomplished on this device. For example, a 600-ampere breaker can be set to trip between 480 and 1200 amperes by a simple screw driver adjustment in the field. The device resets quickly if the current drops to about 90 per cent of pickup value at any time before tripping.

The new device permits a fine degree of time band tolerances and simultaneous adjustments from four to 30 times the minimum pickup setting of the breaker on all three phases with the turn of a knob.

Characteristics can be changed by unplugging the electronic circuitry and replacing it with circuitry giving the new characteristics.

SUPERIOR
CARBON
BRICK
FOR
◀ Blast furnace linings
◀ Blast furnace run-out troughs
◀ Cupola linings
◀ Steel pickling tanks

Standard sizes and shapes • Tested performances
Competent technical service • Superior chemical and metallurgical characteristics • Graphite brick also available.

May we give you a quotation?

ELECTRODE GLC DIVISION
GREAT LAKES CARBON CORPORATION
18 EAST 48TH STREET, NEW YORK 17, N.Y. • OFFICES IN PRINCIPAL CITIES

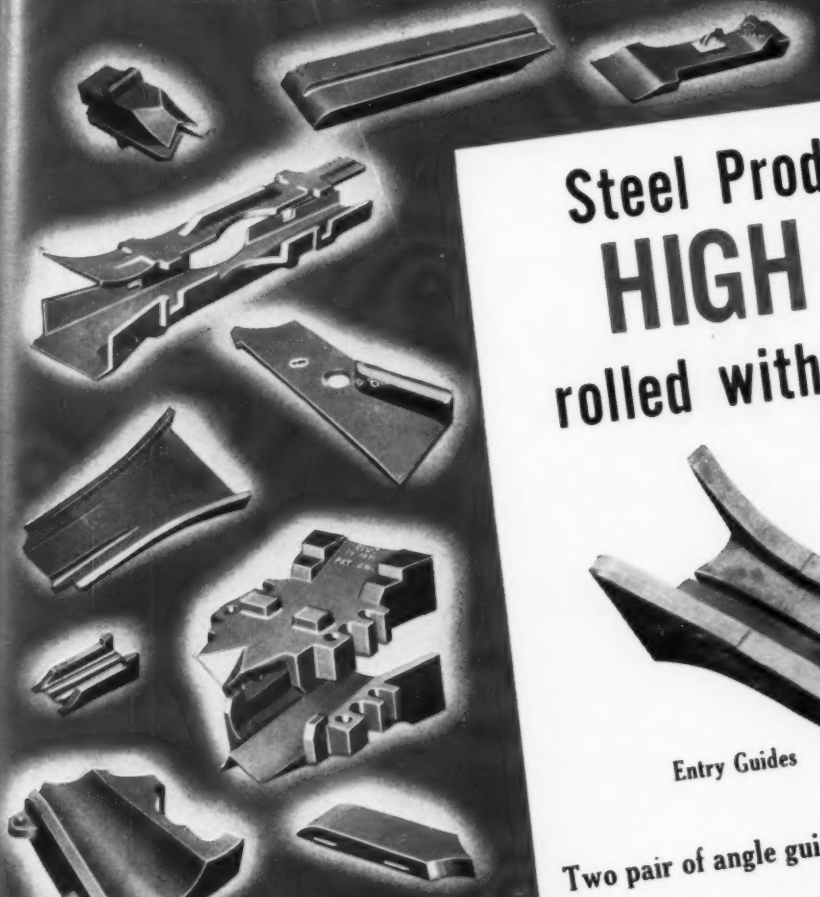
AUTOMATIC BUNDLING

△ A wide range of piercing billets, extrusion billets and wire bars in a variety of metals can now be packaged into uniformly shaped, tight bundles with the development of a fully automatic bundling machine by Loma Machine Mfg. Co. Inc. By using two machines in tandem one bundle may be strapped, either manually or by power strappers, and discharged, while the next bundle is being built up in the other machine.

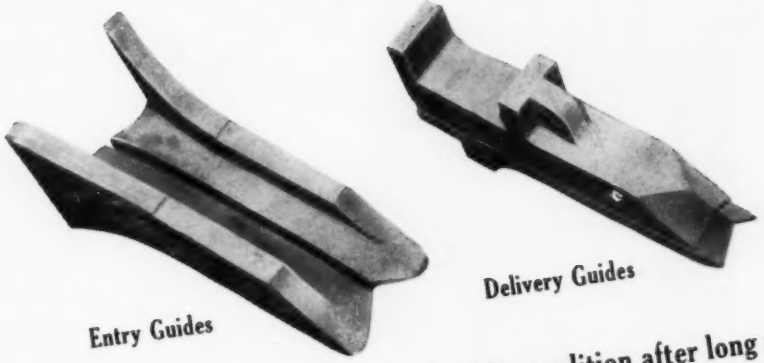
Automatic bundling machine shows completed hexagonal stack of thirty-seven copper billets.

A powered roller conveyor feeds the billets to the bundling machine from such prior operations as casting, sawing, cupping, scalping or inspection. The individual billets are picked up by a lifter and are moved by loading levers into a transfer arm. The stroke of the transfer arm is determined by a signal obtained from the templet which actuates the automatic program control. Once the transfer arm travel stops, the loading levers are retracted

TRANTINYL GUIDES
THE STEEL INDUSTRY



Steel Producers amazed at HIGH TONNAGE rolled with TRANTINYL GUIDES



Entry Guides

Delivery Guides

Two pair of angle guides, still in serviceable condition after long usage

These entry and delivery guides on 12" mill were photographed in a midwest steel plant after rolling unusually high tonnage. Guides showed no noticeable signs of wear and proved again the outstanding durability of "TRANTINYL." If you have not yet tested "Trantinyl" guides to your own satisfaction, why not try them now.

12" Mill showing Entry Guides

"Trantinyl" Guides and Rollers hold exceptionally high tonnage performance records, in serving leading steel mills for a quarter-century. Rolling more than 100,000 tons over a single pair of guides has been recorded.

Guides for Rolling Mills • Tube Mills
Straightening Machine Guides
Heat-Resisting "Trantinyl" Cast-to-Shape

Youngstown Alloy Casting Corporation

Youngstown, Ohio

Sole Licensee to cast "TRANTINYL" for the Midwest, West and South: WAUNAKEE ALLOY CASTING CORP., Waunakee, Wis.

and the billet drops into the cradle. The arm then returns and is ready to pick up the next billet, repeating the cycle. The entire bundling mechanism is subject to electro-hydraulic control and can be set for various billet sizes and stacking patterns by the exchange of templets within a few minutes.

MOTORS

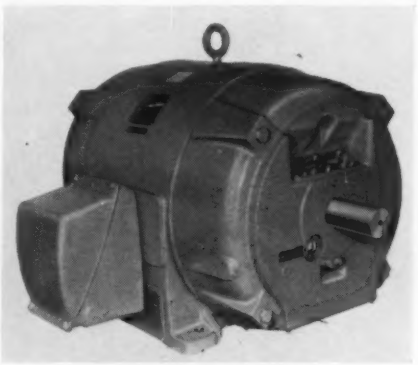
Δ A new line of powerhouse "Life-Line" A motors, from 40 to 250 hp in frames 364U through 506US, is offered by the Westinghouse Electric Corp.

These motors, designed as auxiliary units for generating stations, are furnished in three basic NEMA designs for a wide range of applications: designs A and B (normal torque) for pumps, compressors, fans, blowers, etc.; design C (high breakaway torque) for driving compressors without unloaders, loaded conveyors, certain coal pulverizers, etc.; design D (for high accelerating duty or high inertia loads) for car dumpers, coal trippers, hoists, etc.

Specially designed end brackets provide maximum dripproof protection for the squirrel-cage units. The bearings are oil lubricated sleeve bearings carefully grooved to give positive oil flow. Extra large oil rings provide more oil on the bearing surface. In addition, the large capacity oil sump contains up to 70 per cent more oil than conventional units. An air-bypass is built into the bracket to prevent oil mist being drawn into the motor by the blower.

For longer motor life, "Thermalastic" insulation is used on the larger motors with form-wound coils. Motors with random-wound coils contain powerhouse shielded insulation which gives maximum protection against exposure to high humidity, splashing liquids and mild chemical concentrations.

Other features of the powerhouse



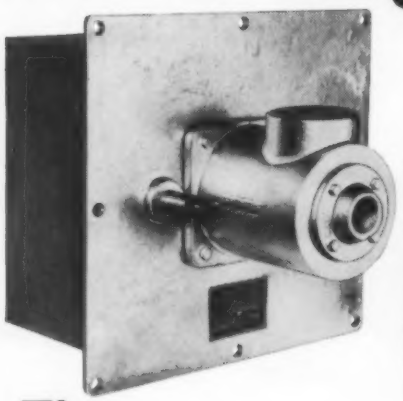
motors include: transparent inspection window for visual inspection of bearing and oil rings; sight oil gauge for instant reading of oil-sump level; air-gap check holes in both brackets for easy checking of air-gap uniformity; oversize conduit boxes for ease in lead connections. Split sleeve bearings and brackets are also available.

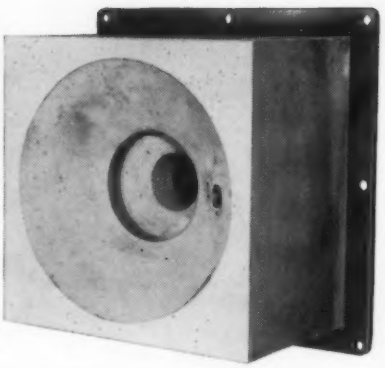
BASALT LINERS

Δ Fused basalt liners of highly abrasion-resisting quality with a hardness of almost 9 compared with a diamond's 10, have been introduced under the trade name of "Abresist" by Basalco, Agents—Engineers.

Complete linings, engineered to fit any existing equipment, contour-shaped to prevent any voids on the surfaces to be covered, are available. Entire flume linings as well as liners for hoppers and chutes have been installed. The liners will wear to a soap-stone-like smoothness, and when compared with similar products of the ceramic type (with the exception of the hardest circon-alumina refrac-

Focus High Heat



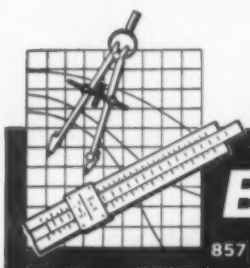


The BLOOM HTR BURNER

The Bloom High Thermal Release Burner can be located in a furnace roof or wall to give the operator the temperature he needs for a given area. Maintenance on this burner is minimized, since alloy or cast iron parts aren't exposed to high temperature.

Applications include:

Tube Upsetting
Continuous Strip Pre-Heating, Annealing, Coating, and Drying
Batch type Forging
Aluminum Chip Melting
Meta-Silicate Melting



BLOOM ENGINEERING COMPANY, INC.
857 WEST NORTH AVENUE • PITTSBURGH 33, PENNSYLVANIA

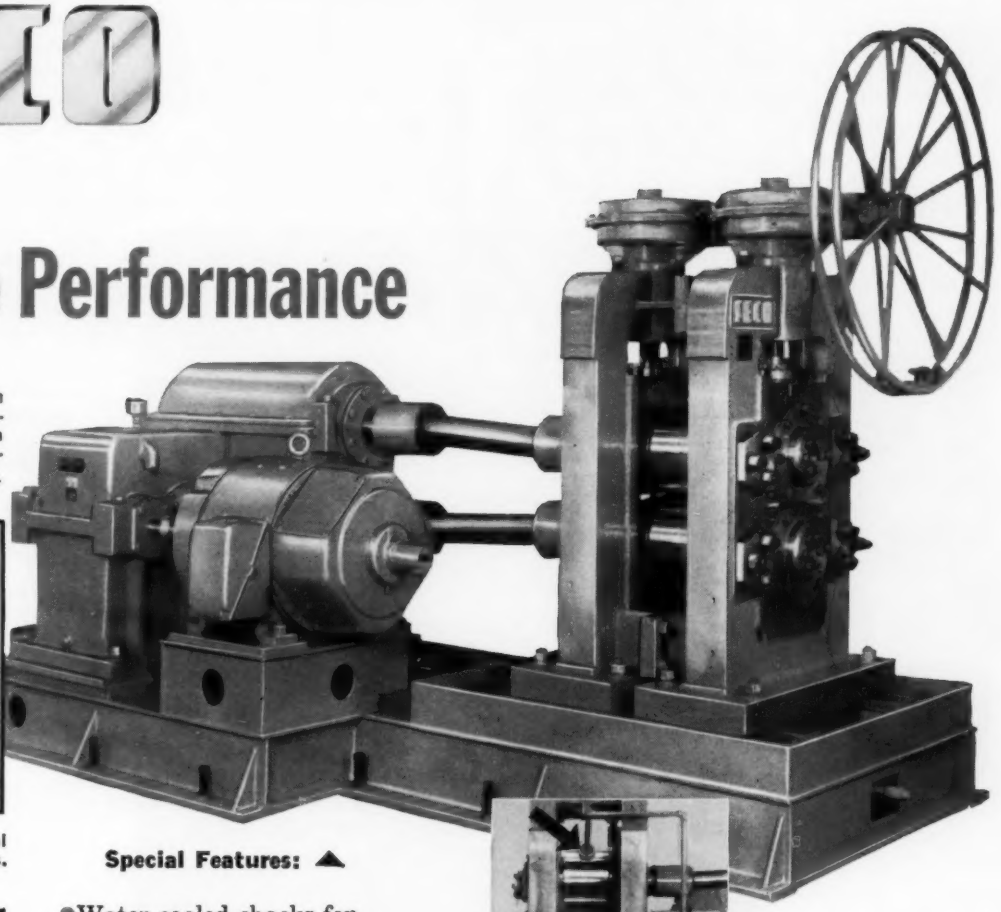
ENGINEERING • EQUIPMENT • SERVICE

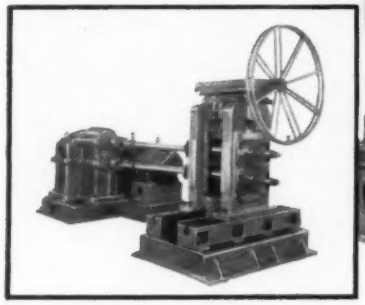
Whatever your requirements . . . SECO's staff of trained engineers can help you solve any special Mill problem you may have . . . from creative designing through installation (including *all* required auxiliary equipment).

Should your problem involve a special Cluster Mill (to accommodate either ferrous or non-ferrous metals), or a Hot Rolling Mill that bonds non-ferrous metal to a steel base . . . SECO can supply.

Custom Built HOT ROLLING MILLS *by* SECO *assures* Predictable Performance

A special, custom-built 2-high Hot Roll Flattening Mill for non-ferrous metals. (Can be built in 2 or 4-high types or a combination of both.) ▶

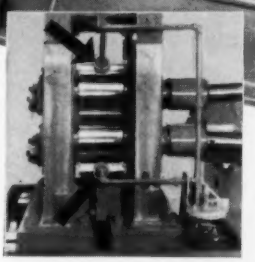




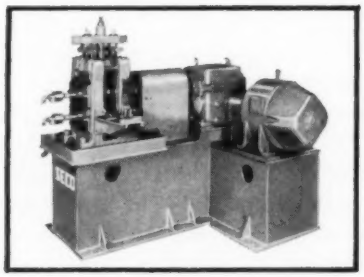
▲ A SECO designed and built Bi-Metal Bonding Mill on movable mountings.

Special Features: ▲

- Water-cooled chocks for lubrication
- 900° F. rolling temperature
- Hand wheel screw-down (adaptable for power)
- Special alloy steel rolls
- Timken Tapered Roller Bearings
- Can be built for 8, 10, 12 or 16-inch widths.



◀ Mill is equipped with two gas jets as a means for pre-heating rolls (see arrows).



▲ A 6-inch, 2-high Wire Flattening Mill for single or tandem use.

SECO

STEEL EQUIPMENT COMPANY

P. O. BOX 737, WARRENSVILLE STATION
CLEVELAND 22, OHIO

SECO STEEL MILL EQUIPMENT

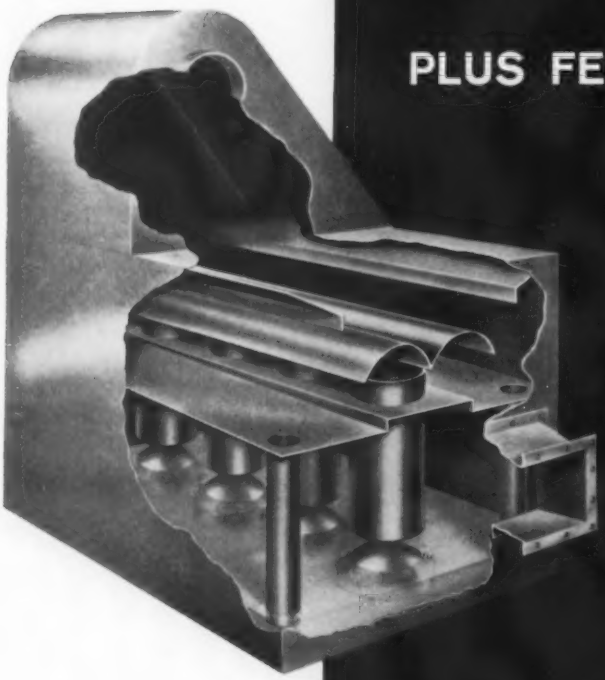
- Leveling and Shearing Lines
- Combination Edging and Flattening Lines
- Tension Reels for Strip Polishers
- Narrow Strip Grinding Machines
- Slitting Lines
- Multiple Strand Pull-out Rolls and Take-up Frames
- Strip Coilers (Up and Down Type)
- Traverse Reels for Narrow Strip
- Steel Coil Up-enders
- Scrap Ballers

Affiliated with Lee Wilson Engineering Co., Inc.

The WHIRLEX ALL NEW MIST-O-MISER DUSTRAXTOR

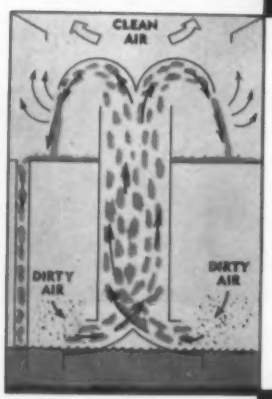
A New Concept in Wet Collection

This unique unit presents an entirely new concept in wet collection. The unit offers a wide range of construction features and methods of dust disposal. The new scrubber forces dynamic dust-liquid contact to insure high collection efficiencies.



PLUS FEATURES

- High volume low space requirements
- High efficiency at low draft loss
- No moving parts
- Minimum water consumption
- Optional construction materials
- Custom designs for special applications



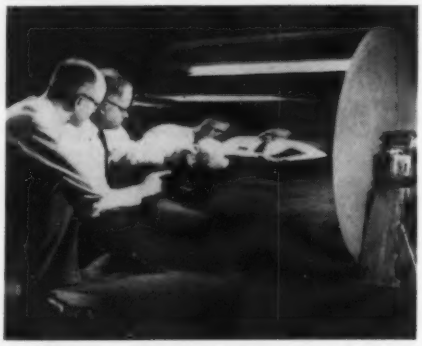
◀ **PRINCIPLE OF OPERATION**

Write for complete information

Dust Collectors ■ Induced Draft Fans
Forced Draft Fans ■ Exhaust Fans
Self Supporting Stacks ■ Duct Work

FLY ASH ARRESTOR CORP.
208 North 1st Street
BIRMINGHAM, ALABAMA

SUB-MICROINCH FINISH



Precision mirror finishes to less than one microinch are now being produced by U. S. Metal Coatings Co. on chromium plated rolls weighing as much as 10,000 lb and as large as 46 in. in diam. Profilometer readings of 0.5 microinch can be attained. The new super finishes will mean more uniform transparency and smoother surfaces than those now obtainable on film and sheet products produced by the plastics and coated paper industries, where large rolls are used in casting and finishing.

tories), is said to outwear them appreciably.

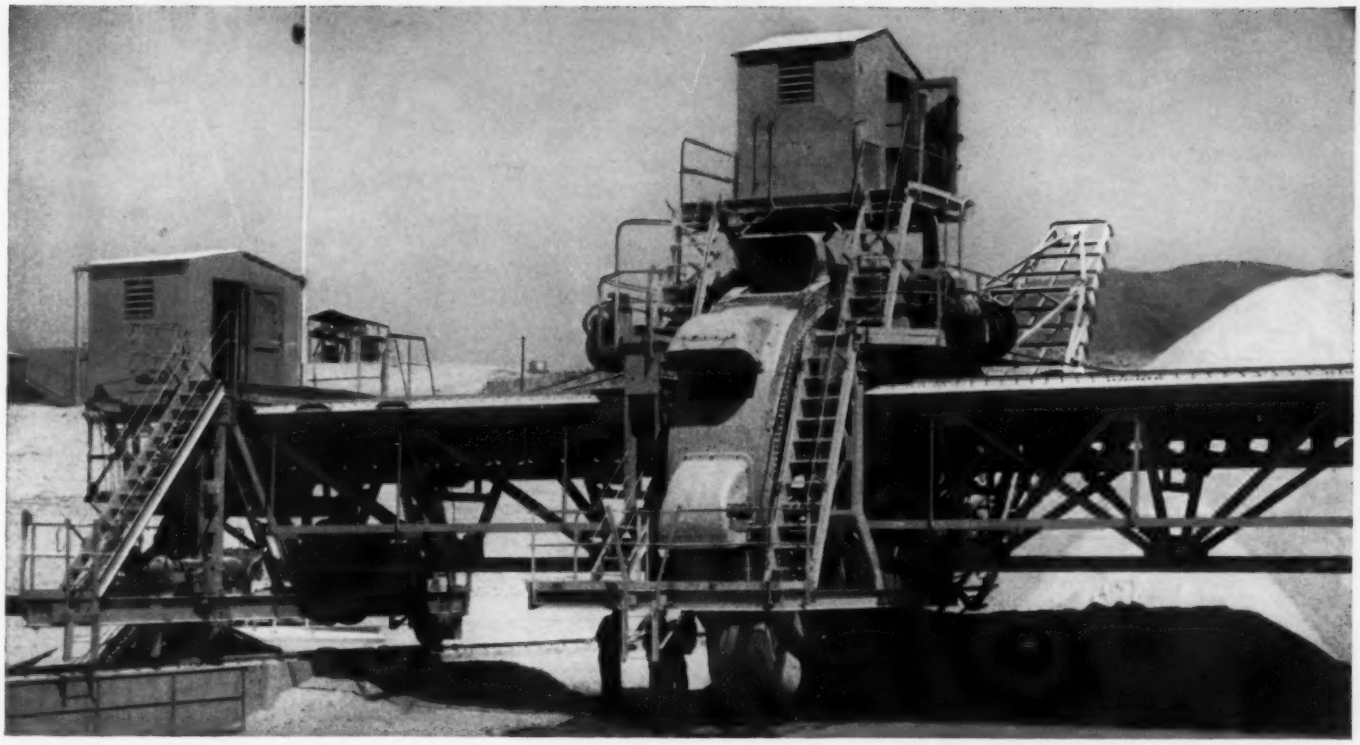
The relatively low cost of "Abresist" is a factor in reducing maintenance costs and frequent downtime. Log-setting plans are furnished for any installation, large or small. Special shapes, within certain limitations, pose no problems. These limitations are the minimum thickness of ¾ in., and outside dimensions of from 10 to 12 in. square, restricted by casting and annealing techniques.

Standard liners are furnished in rectangular, triangular, hexagonal and radial shapes, and in thicknesses of from 1¼ to 2½ in., nominally. The weight of the 1¼ in. thick liners is about 17.5 lb per sq ft, based on a specific gravity of 2.84, and is therefore only 15 per cent heavier than ⅜ in. thick steel plates.

The product, while it is not a refractory material, will withstand temperatures up to 700 F when reached gradually.

Book Reviews

"The Corrosion and Oxidation of Metals," by Ulick R. Evans, has been published recently by St. Martin's Press, 175 Fifth Avenue, New York 10, N. Y. The book contains 1105 pages, 6 x 9 in., is cloth bound and sells for $25.00. This



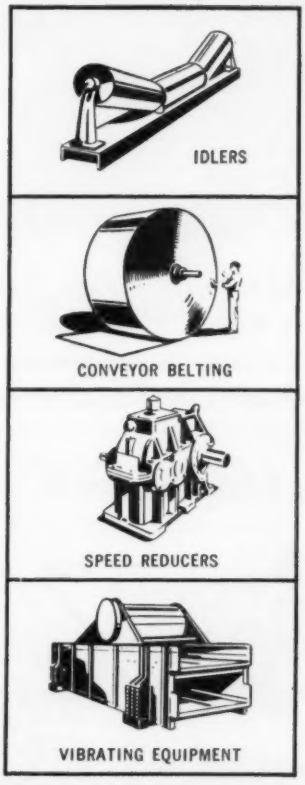
BIG WHEEL

It blends... it reclaims... it ends inefficiencies of selective mining

As part of a new H-R Rotary Bucket Wheel Blending and Reclaiming System, this giant 3-story wheel is capable of processing efficiently a broad range of materials . . . especially where more than one of the following typical situations exist:

1. Engaged in selective mining
2. Unable to comply with specifications
3. Too much coarse or fine material in feed
4. Storage pile requirements range 50,000 tons and over
5. Two or more types of raw material to blend for chemical compounding.

For full details consult your H-R representative, or write Hewitt-Robins, Stamford, Connecticut. Ask for Bulletin 6-50.



HR HEWITT-ROBINS

THE NAME THAT MEANS EVERYTHING IN BULK MATERIALS HANDLING SYSTEMS...

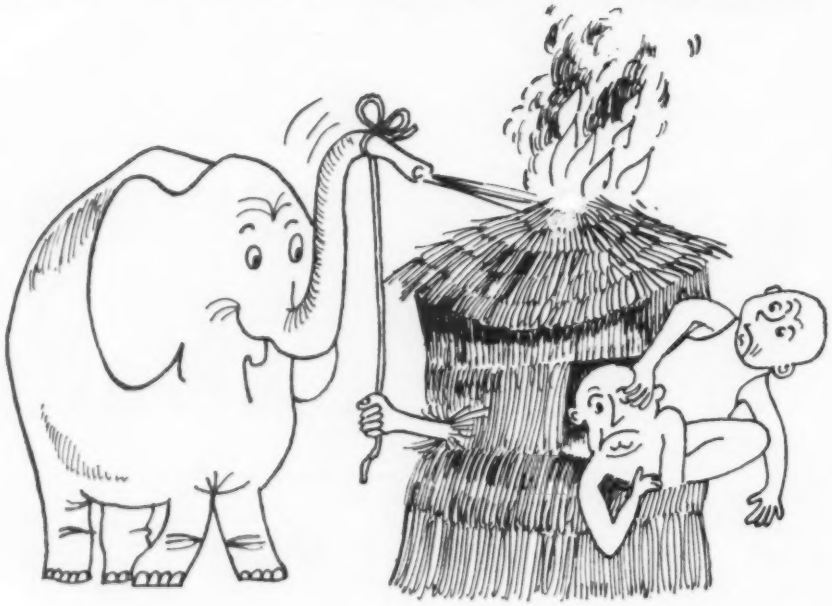
CONVEYOR BELTING AND IDLERS • INDUSTRIAL HOSE • VIBRATING FEEDERS, SCREENS & SHAKEOUTS • POWER TRANSMISSION EQUIPMENT

book covers the author's life-long work in the field of corrosion, and particularly emphasizes recent experimental work. Important theories are advanced and new scientific principles to problems confronting chemists, engineers and architects are applied. The broad scope of the book includes discussions and hundreds of literature references to the published works of other investigators. Scientific aspects are duly stressed on what happens when metals are corroded or oxidized and this material is related to practical applications. At least one-third of the work is devoted to such matters as the protection of steel structures, corrosion inhibitors, treatment of boiler feedwater. Even minor points such as the protection of a new boiler before it is put into service are discussed. Information on laboratory and measurement techniques of value to physicists and chemists doing basic research on corrosion is included. Numerous line drawings, graphs and charts supplement the text. References for further reading are at the end of every chapter; appendices cover chemical principles, physical chemistry and electrochemistry.

"Radiation Pyrometry and Its Underlying Principles of Radiant Heat Transfer" by Thomas R. Harrison has been published recently by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. This comprehensive treatise presents the theoretical and practical principles of radiation pyrometry and is designed to help analyze and solve many questions concerning the use of radiation pyrometers in a variety of industrial conditions. The book discusses the laws of emission, absorption, reflection and transmission of thermal radiation, applied to radiant heat transfer as well as radiation pyrometry. Important descriptions and mathematical analyses of the physical and operating characteristics of radiation pyrometers and the application of emittance corrections are included.

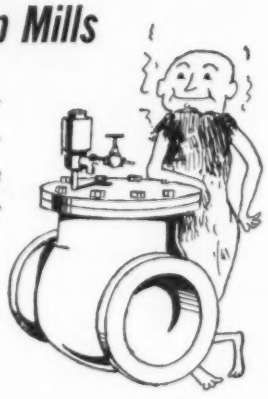
"Long-Term Trends and Problems of the European Steel Industry" (English edition—French and Russian editions will follow shortly) has been published recently by the United Nations Economic Commission for Europe. It is available, in the United States, from International Documents Service, Columbia University Press, 2960 Broadway, New York 27, N. Y.; in the United Kingdom, from H. M. Stationery Office, P. O. Box 569, London, S.E. 1; in Ireland, Stationery Office, Dublin. The edition contains 188 pages, including 116 tables, and 26 charts, and sells for $2.00 (or equivalent in local currencies). This study, undertaken to look into the long-term prospects of the European steel industry, examines developments from 1913 onwards as a guide of the analysis of future trends; it analyzes consumption, production and trade prospects in Europe and the rest of the world some fifteen years hence. It examines raw materials requirements in the light of the production forecasts; examines past and future technological developments of major economic significance and draws attention to some of the main problems arising. The principal outcome of the inquiry is a series of interrelated forecasts of steel consumption, production and trade in finished steel products in 1972–1975,

INSTANT QUENCHING



G-A Quenching Valve *for Hot Strip Mills*

Solenoid Control makes possible "push-button spray" for quenching operations. Instant valve opening . . . and the valve closes just as fast, without hammer or shock.



Write for Bulletins W-7A and SM-1.

GOLDEN ANDERSON Valve Specialty Company

1220 RIDGE AVENUE, PITTSBURGH 33, PA.

Designers and Manufacturers of VALVES FOR AUTOMATION

Mid-States Diversifies Product Line...

Consolidates Lubricant Inventory!

The past twenty years have seen Mid-States Steel & Wire Company greatly diversify their product line while they simplified their lubricants inventory. Today you would find at Mid-States, banks of nail-making machines pouring out over 35 tons of nails every day . . . new fence-making machines . . . machines producing hardware cloth, ornamental wire, baler wire, wire lath, welded fabric, window guards. The list could go on and on.

While the number of products has grown, Mid-States, with the cooperation of Cities Service Lubrication Engineer "Ken" Mosher, have constantly studied their lubrication requirements and have reduced the number of individual lubricants. Pacemaker oil serves as a hydraulic oil and also as a lubricant on many machines. Cities Service multi-purpose Trojan H grease does triple duty throughout the plant. Cutting oils and other lubricants are held to a minimum by selecting a quality lubricant to serve several applications. Reducing the number of lubricants saves valuable warehouse space and cuts the chance of error in servicing machines.

Call your local Cities Service office for a Lubrication Engineer to show you how you can reduce your lubricant inventory. Or for full information write: Cities Service Oil Company, Sixty Wall Tower, N. Y. 5, N. Y.

CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

together with an estimate of the corresponding steelmaking raw materials requirements.

"Mechanics of Materials," by Archie Higdon, Edward H. Ohlsen and William B. Stiles, has recently been published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. The book contains 502 pages, 6 x 9 in., is cloth bound, and sells for $7.75. This book is designed to develop a working knowledge of the relations between the loads applied to a nonrigid body made of a given material and the resulting deformations of the body; a thorough understanding of the relations between the loads applied to a nonrigid body and the stresses produced in the body; a clear insight into the relations between the stress and strain for a wide variety of conditions and materials; an adequate procedure for finding the required dimensions of a member of a specified material to carry a given load subject to stated specifications of load and deflection. For each topic, an illustration is provided enabling the visualation of a physical design problem to which the theory applies. A large selection of problems is included, with special attention devoted to problems that require an understanding of the principles of mechanics of materials without demanding excessive time for computational work.

"Ferrous Metallurgy Laboratory Manual" by Joseph S. Umowski has recently been published by the American Technical Society, 848 East 58th Street, Chicago 37, Ill. The book contains 83 pages 7 × 10 in., is bound in heavy paper cover, and sells for $2.25. This book contains background information, general theory, and explanations of a step-by-step presentation of laboratory experiments, together with glossary for handy reference to terms commonly used in metallurgy. It is intended primarily to supply more than textbook information on the heat treatment of steels, it provides training material, and helps serve technical personnel with little or no investigative experience in a laboratory.

. . . withstand temperatures to 3,500° F., extreme abrasion, slag formation

These refractories form exceptionally stable, non-wetting linings that have amazing load-bearing strength and resistance to ferrous metal penetration.

80-95% Alumina . . . New Pli-Ram Mixes are specially formulated from select ores for high temperature installations where molten aluminum and iron oxide are the chief causes of lining failure.

Specially formulated for these and similar installations:

- Aluminum remelt furnaces
- Brass and aluminum ladles
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- Electric furnace roofs
- Slab reheat hearths
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Call your local Plibrico man to show you where and how New Pli-Ram Mixes can save you money

Pli-Ram "80" (heat setting)
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Pli-Ram "95" (air setting)

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THE NEARLY 100% CURABLE CANCER!

A simple, painless examination, the "Pap smear", helps physicians detect cancers of the uterus *in time*. When discovered early and properly treated, this second most common cancer in women is nearly 100% curable.

Our film, "Time and Two Women" will show you how to guard yourself against uterine cancer. It has already saved many lives. To see it, call the office of the American Cancer Society nearest you, or write to "Cancer", c/o your local post office.

AMERICAN CANCER SOCIETY

NEW

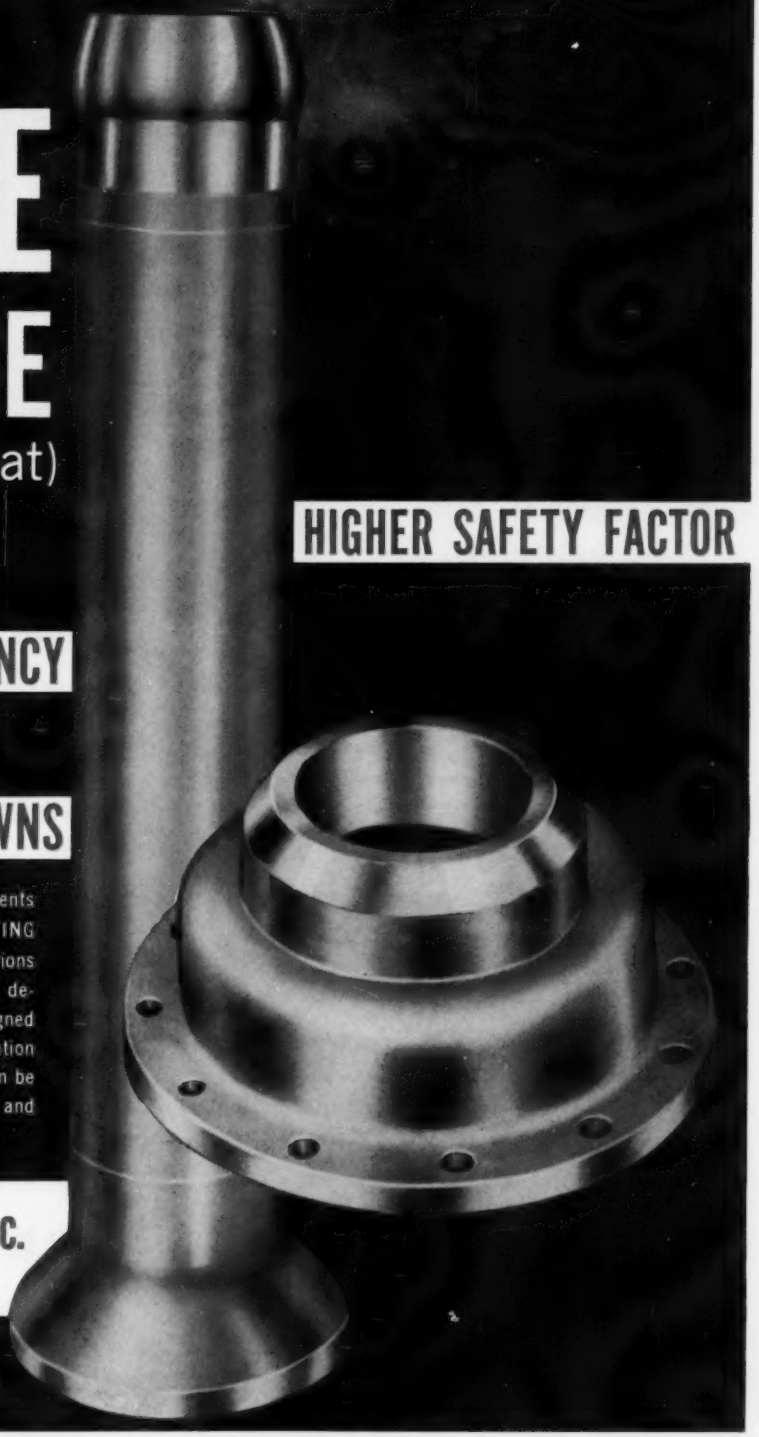
ONE PIECE BLOW PIPE (and seat)

HIGHER SAFETY FACTOR

INCREASES EFFICIENCY

ELIMINATES COSTLY BREAKDOWNS

One of the latest developments in blast furnace components . . . A ONE PIECE CENTRIFUGALLY CAST HEAT RESISTING ALLOY BLOW PIPE AND SEAT. Formerly cast in three sections and welded; the new one piece Cleveland Alloy Method decreases costly break-downs due to weld burn-outs. Designed to withstand increased temperatures. Refractory insulation liner optional. Cleveland Alloy Blow Pipes and Seats can be produced in a range of analysis including columbium and nitrogen stabilized alloys.



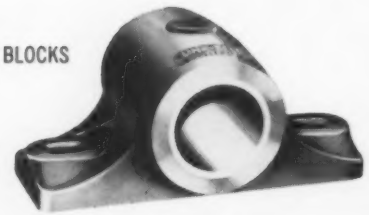
Cleveland Alloy Castings, Inc.

20303 FIRST AVENUE • BEREA, OHIO

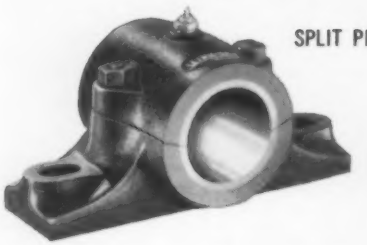
LINK-BELT'S babbitted and bronze bearing line offers

all these designs

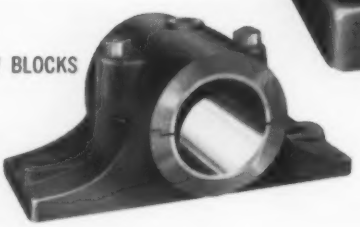
SOLID PILLOW BLOCKS



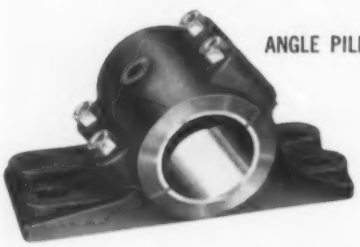
SPLIT PILLOW BLOCKS



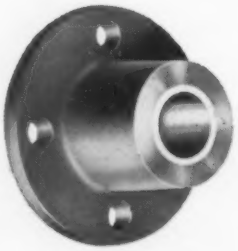
GIBBED PILLOW BLOCKS



ANGLE PILLOW BLOCKS



FLANGED BLOCKS



all these features

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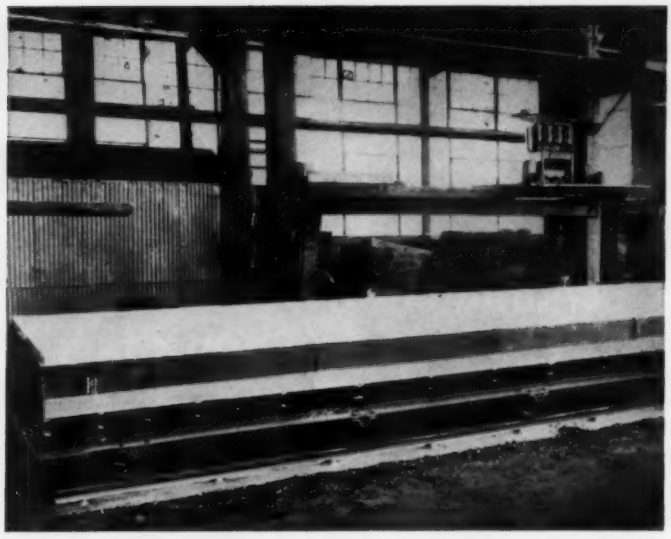
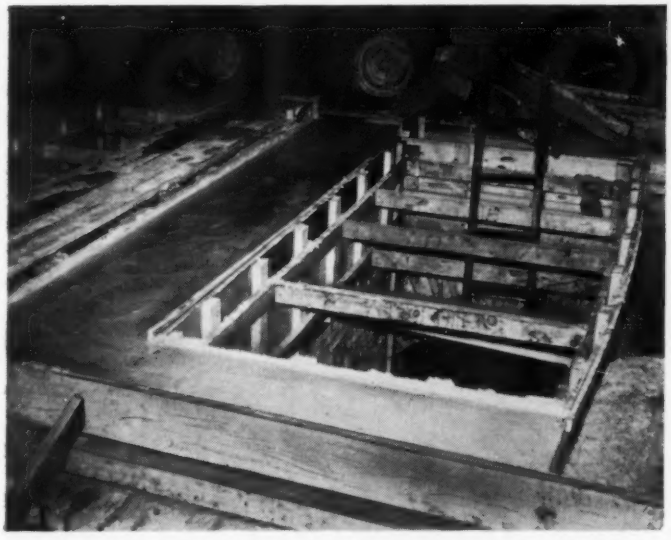
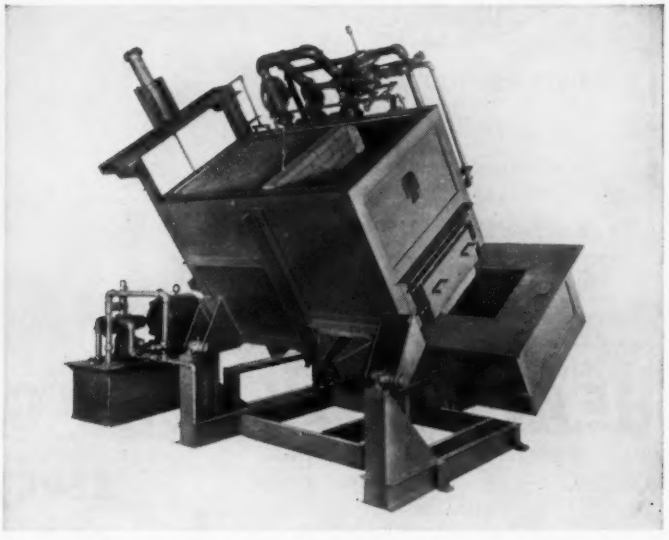
In this stress-relieving furnace, B&W Kaocrete-D is used on the floor ledges, car top, in the door jamb and at the end of the flat roof where it withstands the abrasion of the door. This material is specially designed to withstand severe abrasive conditions and mechanical abuse.



Heavy duty car top service requires a high strength castable. B&W Kaocrete-D is excellently suited for this service at temperatures to 2500 F. B&W Kaocrete-32 is recommended for service above this range.



B&W Kaocrete-32 has been cast to form the curb walls of a soaking pit. When mechanical abuse from ingots damages the curb, Kaocrete-32 has the necessary properties to localize the damage, thus maintaining the serviceability of the rest of the curb.



The castable lining of this aluminum reverberatory furnace must have unusually high strength to withstand the considerable physical abuse of charging, operating and cleaning, while resisting the penetration of the molten metal. Kaocrete-D is widely used in this application.

How B&W refractory castables solve abrasion problems

Refractory castable linings used in metal-working furnaces are often subjected to severe mechanical abuse. Scraping by hand tools, loading and unloading, and the action of the molten metal and particle-laden gases all affect the life of refractories. Among B&W's line of refractory castables are two that are particularly suited to withstand unusual abrasive conditions. They are B&W Kaocrete-D and B&W Kaocrete-32, both of which have been used successfully in many demanding applications.

B&W Bulletin R-35A gives additional information on versatile B&W refractory castables. Write for copy to The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N.Y.

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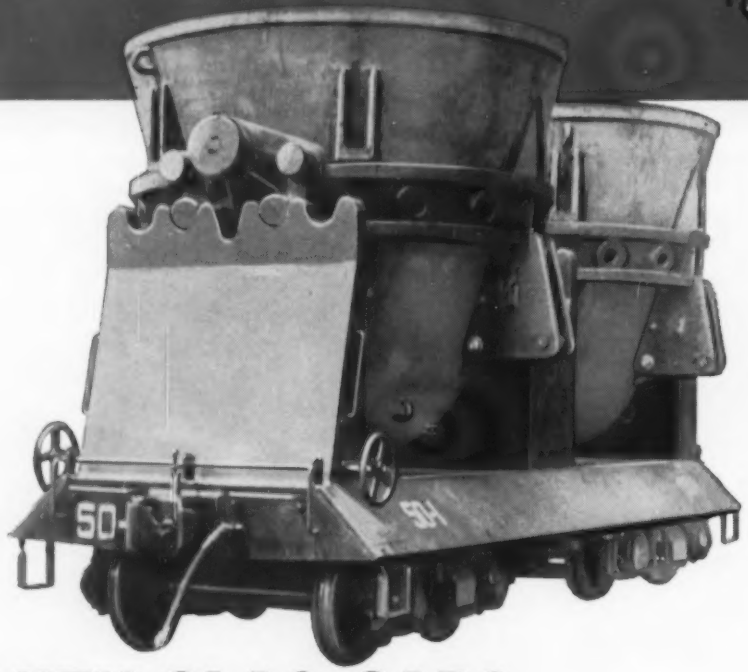

This is one of the Pollock open hearth double-pot slag cars in service at the Edgar Thomson plant of United States Steel Corporation. Identical equipment will be used in other new plants now under construction.

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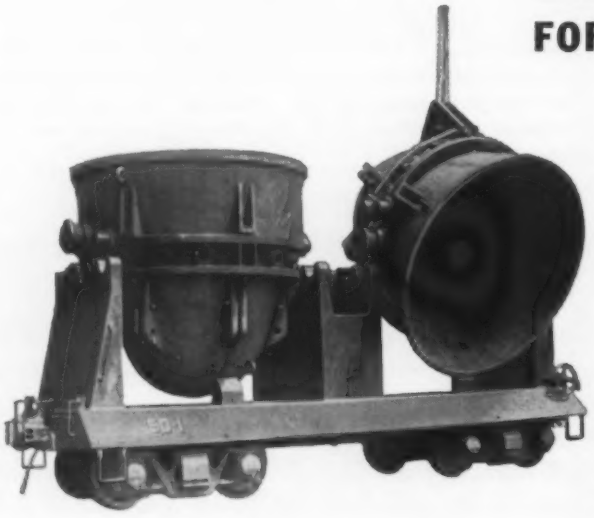

• Note the heavier construction used in every detail of this double-pot, crane-dumped car. This extreme ruggedness is a necessity to assure longer life and trouble-free service under present-day big-tonnage production.

In addition to the more sturdy construction, design features contribute to open hearth operational advantages. The unit is unusually compact and permits use with minimum allowances for space clearances. Simplicity of structure reduces maintenance time and retards deterioration. Cradle arrangement permits easier, faster dumping from either side.

Each pot holds 400 cubic feet which provides 800 cubic feet slag disposal capacity within 29'0" coupler to coupler.

Most new open hearth plants have Pollock hot metal and slag handling equipment because Pollock engineering is geared to mesh with overall efficiency planning. Also for open hearth ladles, ingot cars and charging box cars, consult Pollock before you invest.

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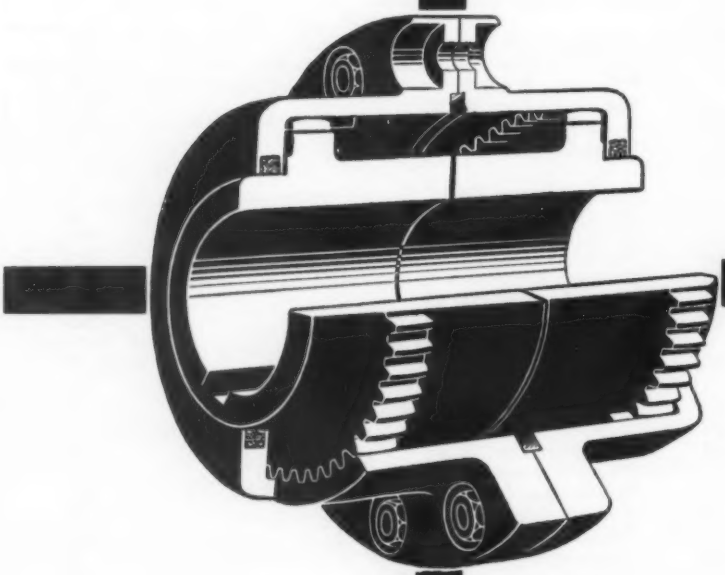

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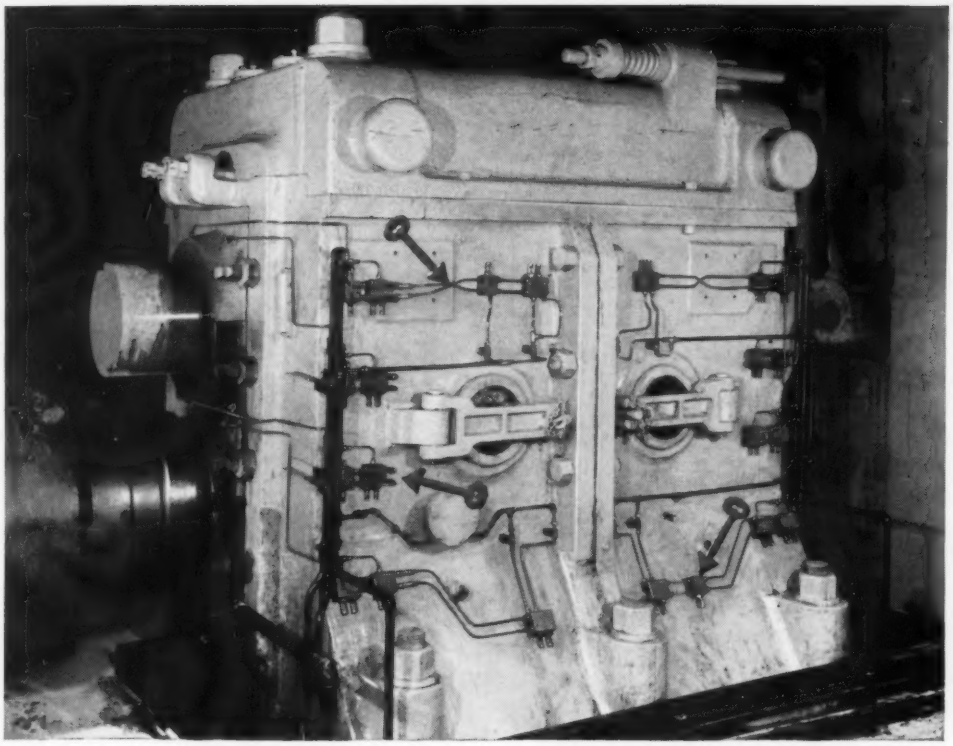

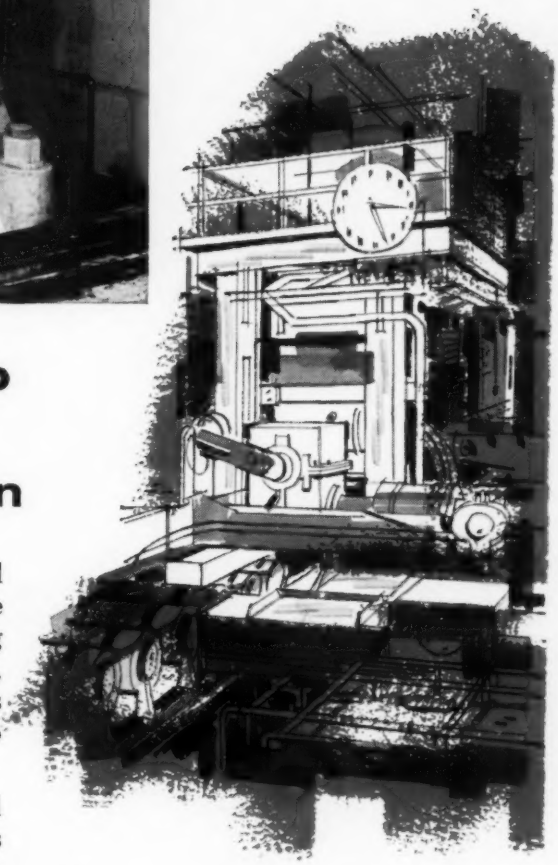

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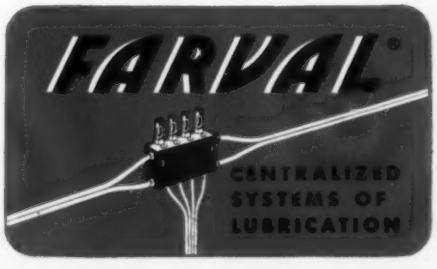

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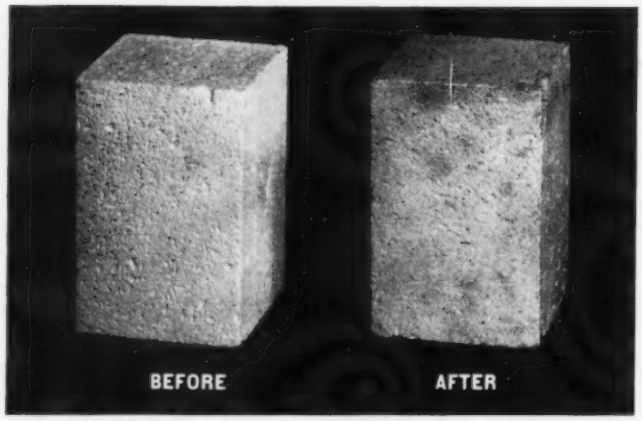

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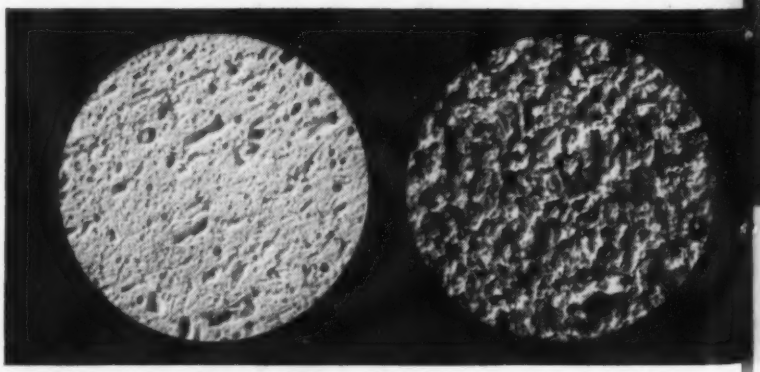

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